A RURAL ARITHMETIC

A TEXTBOOK
FOR GRAMMAR GRADES AND SECONDARY SCHOOLS

BY

IRWIN A. MADDEN

Professor of Agriculture
Illinois State Normal University

AND

EDWIN A. TURNER

Director of the Training School
Illinois State Normal University

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PREFACE

Economy in education demands that subject-matter be selected on the basis of its intrinsic value, rather than on the basis of its indirect or cultural values, since these indirect values naturally obtain as a by-product. Because of this growing conviction of the relative importance of educational values, authors of recent texts in arithmetic have shown, in the choice of materials, a strong tendency to emphasize concreteness, connectedness, and practicability.

With a constantly increasing tendency toward specialization the task of selecting miscellaneous lists of problems and of treating general arithmetical topics in a concrete, connected, and practical way is becoming increasingly greater from year to year. A strong conviction of the importance of emphasizing intrinsic values has led to a sharp break in the use of materials and methods which have become traditional.

The authors are of the opinion that rural life, which directly concerns more than fifty per cent of the American people, has sufficient mathematical content to supply adequate incentives and materials for the mastery of the fundamental principles and habits involved in the solution of the practical problems of life. They believe further that arithmetic should be treated as a means to an end and not as an end in itself. As a means, arithmetic becomes but a phase or aspect of a larger division of human thought. Rural life involves problems of soil improvement, crop improvement, feeding, building, fencing, marketing, fruit-growing, cooking, decorating, commerce, business forms, and accounts. Viewed from this angle, mathematical problems naturally arise in connection with economic problems. This notion of the relation of arithmetic to rural life at once lays the foundation for an entirely

new organization of materials. It provides the opportunity of grouping the fundamental processes of arithmetic around large units of subject-matter related to rural life, and thus precludes the necessity of doling out a series of small and relatively uninteresting arithmetical topics in the customary way. This treatment emphasizes arithmetic as a means to an end, rather than an end in itself. In order that this natural and simple treatment of arithmetical processes may be utilized without seriously disturbing present school organizations and without jarring the nervous organisms of those of us who have become accustomed to the traditional method of treating the topics of arithmetic in the so-called "logical" order, introductory and connecting chapters are employed.

Chapters upon the fundamentals, fractions, and percentage, etc., in which there is an abundance of drill exercises and an adequate development of principles, provide for the substitution of this book for other grammar-grade texts after the sixth year in rural communities. The variation, gradation, and amount of the materials employed are adequate to provide sufficient mathematical training for pupils in the grammar grades, the high schools, and for special classes in normal schools and institutions of like character. It should be noted also that problems related to the interests of girls have been provided as well as problems which make a strong appeal to boys.

The problems of this book are based upon the results of scientific investigations at the various agricultural experiment stations and elsewhere throughout the country. All of the data are based upon fact and not upon presumption. It is believed that this source material will stimulate a scientific attitude toward rural problems as well as give a concreteness and practicability to problems of arithmetic which has not heretofore been experienced.

The authors wish to express their appreciation of the splendid work that has been done at the several experiment stations throughout the country which has made this book possible. They wish also to acknowledge their indebtedness to Messrs. Wright and Funk, of

the Wright-Funk Farm, for the valuable data supplied by them; to Mr. George Cade, principal of the Elementary Training School of the Illinois State Normal University, for practical suggestions on the chapter on Measurement; to Miss Agnes Story, critic in the Training School of the Illinois State Normal University, Professor I. N. Warner, of the State Normal School, Platteville, Wis., and Professor Carl Colvin, of the State Normal School at Charleston, Illinois, for a critical examination of the manuscript; to J. A. Nye, of the University of Minnesota, for the basic materials on Farm Accounts; to Dr. S. A. Courtis, originator of the Courtis Tests in Arithmetic and Supervisor of Educational Research, Detroit Public Schools, for permission to use the problems of his Series B Tests; and to Houghton Mifflin Co. for permission to use the captions "With pencil" and "Without pencil" from the Hoyt and Peet "Everyday Arithmetics."

SUGGESTIONS TO TEACHERS

The exercises in this book were prepared to meet the arithmetical needs of seventh- and eighth-grade pupils and those pupils in the high schools, normal schools, and institutions of a similar character, who are pursuing courses in rural life, agriculture, and home economics.

During the first six years of school life the child gets his first view of the fundamentals of arithmetic. He also gains some skill in the use of numbers. As a rule, however, he is woefully inaccurate and but ill prepared to apply the principles learned to the solution of everyday problems. The problems of this book are admirably suited to stimulate interest and skill in the solution of common problems.

Nearly one fourth of the book is given over to a systematic review of the fundamental operations of arithmetic. The method employed is intended to make this review a new view. The problems in the review are drawn from such familiar and interesting situations that an appeal is assured. Problem-solving alone will not insure accuracy and speed in multiplication, division, subtraction, and addition. To insure this accuracy and speed it is recommended that teachers provide formal drills, both written and oral. These drills should not exceed five minutes daily. With average classes, a three-minute period is ample to secure good results. It is suggested that the tests given on pages 8 to 17 be given in the fall and in the spring in order to determine the relative abilities of the pupils. When pupils fall far below the average, they should receive special attention.

The introductory exercises to the various chapters dealing with the fundamentals are intended to improve the thinking and mathematical English of pupils. Bad form usually, though not always, results from careless thinking. These introductory exer-

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cises were planned to insure careful thinking and to provide forms appropriate to such thinking. "An ounce of prevention," in this phase of the work, "is worth a pound of cure" later. It is quite important that teachers work for careful thought and expression throughout the early chapters of this book. A careful use of the type exercises provided will aid materially in securing proper habits.

The later chapters of the book provide an abundance of concrete and practical problems for the application of principles. In these chapters speed and accuracy should receive relatively more consideration than form. Short cuts should be encouraged in an endeavor to get practical results.

The problems in these later chapters are based upon data drawn from experimental situations of a very practical nature. Teachers should dwell somewhat upon the far-reaching significance of experimental results of this sort. Since most of these problems are based upon tables compiled from experimental results, it is advisable to give some consideration to methods of carrying on such experiments and to discussions relative to the meaning of the various parts of the tables. Exercises of this kind will insure both clearness and motive.

Teachers of seventh and eighth grades are aware of the wide variability in the abilities of their pupils. It is believed that the abundance and character of the problems will meet the needs of such wide variabilities. The strongest pupils should be required to work all of the required problems and be permitted to solve some or all of the optional problems, provided this can be done while the weaker pupils are completing their assignments. If the required list is quite long, it is not wise to insist that the weakest pupils solve all of the problems in it. An adaptation of this sort will provide adequate work for all and ultimately insure for all the ability to control concrete situations, and provide for a consistent forward movement.

Nothing is quite so disheartening to strong, vigorous children as "being held up" while the weak children of the class are helped by the teacher. On the other hand, nothing is quite so enervating

to children of mediocre ability as being freed from a definite responsibility. The arrangement and gradation of the problems in the applied chapters of the book provide for taking care of both types of children.

Teachers of special classes in the high schools and higher institutions will find their pupils frequently faulty in both a knowledge of the fundamental processes of arithmetic and skill in the fundamental operations. To meet the needs of such classes it is recommended that some time be given to a review of the beginning chapters which have been prepared especially for this purpose.

Before taking up the problems listed under the tables in the various sections, it is suggested that a review of the details of the experiment be given. Many of the easier problems should be worked orally by advanced classes. The more difficult problems of the required lists and of the optional lists will provide situations sufficiently difficult to tax the energy and ingenuity of the strongest pupils. It is intended that all students in these special classes be held for all of the optional problems.

Students in special classes should be held rigorously at the very outset for honest and earnest effort. An approximation of answers should not be tolerated. Loose habits of this sort lead inevitably to a lack of interest in the subject and to bad habits of execution. The problems are arranged to develop a tendency or "bent of mind" toward the solution of the fundamental problems of rural life. Carelessness or indifference in the solution of these problems will thwart the purpose back of this arrangement.

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CHAPTER I. FUNDAMENTAL PROCESSES

NOTATION AND NUMERATION

WRITING numbers is called *notation*. Speaking or reading numbers is called *numeration*.

1. Practice in Arabic Notation

Arabic notation is the process of expressing numbers by use of the ten digits (0, 1, 2, 3, 4, 5, 6, 7, 8, 9), and the decimal point (.).

1. Express the following numbers by means of the Arabic notation: twenty-two; one hundred seven; four hundred twenty; nine hundred forty; forty thousand nine hundred one; four million twenty-one thousand twenty.[1]

2. Read from the following table the number of pounds of milk produced each week for 8 weeks, at the Illinois Experiment Station, by two groups of cows consisting of 9 each:

TABLE 1

Week	Group 1	Group 2
1	2384 lb.	2279 lb.
2	2315 "	1947 "
3	2189 "	1811 "
4	2205 "	1739 "
5	2271 "	1581 "
6	2229 "	1537 "
7	2255 "	1421 "
8	2259 "	1652 "

[1] There should be constant drill upon the writing of numbers until a high degree of speed and accuracy is secured in arranging the digits of a series of numbers in the proper columns.

3. Read from the following table the number of pounds of milk produced each week by the 9 cows of each of the following groups:

TABLE 2

Week	Group 1	Group 2
1	2315 lb.	1947 lb.
2	2189 "	1001 "
3	2205 "	1729 "
4	2259 "	1652 "
5	2271 "	1581 "
6	2229 "	1037 "
7	2253 "	1421 "
8	2259 "	1468 "
9	2198 "	1423 "
10	2121 "	1301 "

2. Periods in Arabic Notation

For convenience of reading, numbers are separated by commas into groups of three figures each. Each group of figures is a period.

1. Read the following number:

420,	124,	480,	601
Billions	Millions	Thousands	Units

NOTE: The above number is read: 420 billion, 124 million, 480 thousand, 601.

2. Read the following numbers:

(1)	1	(8)	21436
(2)	44	(9)	423684
(3)	361	(10)	1234004
(4)	9426	(11)	84236
(5)	84321	(12)	46236
(6)	242424	(13)	724363
(7)	8643214	(14)	3729623

3. How many "periods" are there in each of the above numbers?

4. Express in figures:

(With pencil)

(1) One hundred four.
(2) One hundred forty-four.
(3) 4 thousand 4 hundred seven.
(4) 40 thousand four hundred four.
(5) 404 thousand 404.
(6) One million 80 thousand twenty-eight.
(7) One million 406 thousand 264.
(8) 40 million 40 thousand 436.

3. Practice in Roman Notation

Roman notation is the process of writing numbers by the use of capital letters. This notation is sometimes employed in numbering chapters in books, hours on the faces of clocks, in designating different monarchs of the same name, etc.

1. Express the value of the following letters in Arabic notation: I, V, X, L, C, D, M. (Consult the dictionary if necessary.)

2. IV = 4; IX = 9; XL = 40; XIV = 14; XIII = 13; XC = 90. How is the value of a Roman numeral affected by placing a numeral of less value immediately in front of it? How is it affected by placing numerals of less value immediately after it? Illustrate.

The value of a symbol which follows one of equal or greater value is added to the one which precedes it. Thus, II = 2; XI = 11. The value of a symbol which precedes one of greater value is subtracted from it: IV = 4; XL = 40. When a symbol stands between two of greater value its value is subtracted from the last and the remainder is added to the first: XIV = 14; LIX = 59. Of the two equivalent ways of representing a number it is preferred that the symbol of larger denomination precede the smaller one. 14 should be written XIV and not VIX. 45 should be written XLV and not VL.

Read the following numbers:

3. VI, XV, LX, CL, DC, MC.

4. IV, XL, CD, CM.

5. XLV, XC, LDX, MCD.

6. XIV, LXVI, XLVI, XLIV.

7. CLXL, CLIX, MCM, MDCCC.

(Without pencil)

8. Express the following numbers in Roman notation: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 1916, 1917, 1918, 1919, 1920, 1950, 2000.

ADDITION AND SUBTRACTION

4. Practice in Addition

Lack of confidence and failure in the operations of arithmetic are due to the fact that pupils do not know the fundamentals. It is suggested that a lively drill be carried on each day for a period of from three to five minutes. Speed and accuracy are both essential to success. Both are made more certain by reducing addition and subtraction to the single process of addition.

(With pencil)

1. Before being loaded for shipment, 120 steers were weighed in groups of 4 upon platform scales. The following weights were recorded. What was the total weight of the shipment?

3420 lb.	3821 lb.	4199 lb.
3640 "	4228 "	3919 "
3780 "	4522 "	4073 "
4284 "	3860 "	4029 "
4420 "	3600 "	4636 "
3627 "	4636 "	3760 "
4136 "	4192 "	3950 "
4024 "	3996 "	4175 "
3823 "	4061 "	4280 "
4228 "	3840 "	4060 "

2. A coal dealer distributed a carload of coal to two of his customers as follows:

To Mr. A.	4484 lb.	To Mr. B.	4500 lb.
	4624 "		4489 "
	4690 "		4732 "
	4531 "		4398 "
	4720 "		4470 "
	4321 "		4621 "
	4499 "		4321 "

How many pounds did the car contain?

3. The following daily purchases were made at a grocery store during the month of October by a family of four living in a small town. Determine the total amount of the grocery bill.

Oct. 1.
Apples.........$ .10
Ammonia...... .10
Cleanser........ .10
6 bananas...... .08
Macaroni....... .10
Nabiscos....... .10

Oct. 2.
Butter.........$ .40
Syrup.......... .25
Bread.......... .05

Oct. 4.
Bread..........$ .10
Pineapple...... .25
Cheese......... .10
Pecans......... .10
Butter......... .40
Bacon......... .35
Pie............ .10
Potatoes....... .25
Oranges........ .20

Oct. 6
Butter.........$ .40
Corn........... .25
Bread.......... .25
Cheese......... .10
Bananas....... .10
Pecans......... .10
Cake.......... .20

Oct. 9.
Butter.........$ .35
Apples......... .25
Celery......... .05

Oct. 10.
Potatoes.......$ .25
Vinegar........ .25
Oil............ .15
Bread......... .05
Brown sugar.... .10
Ammonia...... .10
Lemons........ .05

Oct. 12.
Nabiscos.......$ .10
Celery......... .10
Flour.......... .80
Lettuce........ .05

Oct. 14.
Bread.........$ .05
Cheese......... .10
Crackers....... .15
Nabiscos....... .10

Oct. 15.
Bananas.......$ .10
Oranges........ .15
Bread.......... .05
Crackers....... .05
Peanut B....... .10

Oct. 17.
Qt. gasoline.....$ .05
Potatoes....... .25
Pecans......... .10
Nabiscos....... .10
Apples......... .10
Celery......... .10
Eggs........... .20

Oct. 19.
Salt............$ .05
Raisins........ .15
Oysters........ .10
Cranberries..... .10
Apples......... .30
Yeast.......... .04
Nabiscos....... .10
Bananas....... .08
Oranges........ .15
Lemons........ .10

Oct. 20.
Sugar..........$1.35
Butter......... .40
Oysters........ .10
Grape-fruit..... .25

Oct. 21.
Gelatin........$ .25
Salmon........ .25
Lettuce........ .05

Oct. 22.	
Potatoes	$ .15
Apples	.10
Crackers	.05
Dates	.10
Bread	.05
Yeast	.02
Oct. 23.	
Oysters	$ .10
Cocoanut	.10
Bread	.05
Crackers	.05
Corn	.25
Oct. 24.	
Crackers	$ .25
Bacon	.35
Potatoes	.25
Oct. 26.	
Yeast	$ .04
Gra. flour	.20
Oatmeal	.10
Grapenuts	.15
Oysters	.10
Bread	.05
Nabiscos	.10
Oct. 29.	
Oil	$ .15
Nabiscos	.10
Ammonia	$ .10
Crackers	.10
Bread	.05
W. powder	.05
Oct. 30.	
Bread	$ .05
Gasoline	.05
Apples	.10
Oct. 31.	
Lard	$ .95
Crackers	.05
Bread	.05
Nabiscos	.10

4. Determine the total acreage and the total yield of the following crops produced in the United States in a recent year:

TABLE 3

Crop	Acres	Bushels
Corn	114,002,000	3,125,713,000
Wheat	49,205,000	695,443,000
Oats	35,288,000	1,126,765,000
Rye	2,028,000	33,039,000
Barley	7,257,000	162,227,000
Buckwheat	826,000	17,239,000
Flaxseed	2,916,000	14,116,000
Rice (rough)	722,800	24,510,000
Potatoes	3,591,000	338,811,000

5. How much more corn than wheat was raised?

6. How many more acres were planted in corn than in wheat?

7. Determine the total number of farm animals reported in the United States for a recent year, as given in the following table:

Horses	21,040,000
Sheep	57,026,000
Mules	4,123,000
Cattle of all kinds	89,080,000
Swine	47,782,000

8. How many more sheep than hogs were reported?

9. Give the combined weight of 8 pigs whose weights were recorded at the Nebraska Experiment Station as follows: 172 lb., 176 lb., 171 lb., 172 lb., 156 lb., 158 lb., 163 lb., 168 lb.

10. The 8 pigs during the 12 weeks of a feeding test ate the following amounts of corn respectively; 428 lb., 321 lb., 321 lb., 321 lb., 299 lb., 207 lb., 211 lb., 211 lb. How much did they all eat?

11. An agent for the British Government purchased 10 mules from a Missouri farmer at the following prices: \$186, \$190, \$210, \$240, \$245, \$250, \$250, \$222, \$222, \$240. How much did the farmer receive for the 10 mules?

12. Solve the following problems in addition as rapidly as you can:

(1)	(2)	(3)	(4)
3421	1104	9982	2736
8462	8132	4321	3721
5432	3694	1826	4276
1398	7286	5324	8236
6472	2432	8021	1489
5371	8246	9674	3621

(5)	(6)	(7)	(8)
4637	8256	5566	6532
3246	3355	4421	5643
1495	7721	1498	3427
3227	1292	9719	7892
8764	4651	7156	2946
7842	5684	8829	7711
6236	9811	3342	3291
1492	4463	5164	4263

Standard lists of problems in each of the fundamental processes are given to determine the relative skill of an average child of each class. It is suggested that these problems be used for this purpose only. By permission of Dr. S. A. Courtis the test problems used here are copied from his *Standard Tests*. Copies of the *Courtis Standard Research Tests* may be secured from the author at Detroit, Michigan.

5. Addition Test[1]

Work as many of the following problems as you can in eight minutes:[2]

(1)	(2)	(3)	(4)	(5)	(6)
127	996	237	386	186	474
375	320	949	463	775	787
953	778	486	827	684	591
333	886	987	240	260	106
325	913	354	616	372	869
911	164	600	261	846	451
554	897	744	755	595	336
167	972	195	833	254	820
554	119	234	959	137	533

(7)	(8)	(9)	(10)	(11)	(12)
877	537	237	564	632	674
845	685	492	278	263	158
981	452	679	947	318	745
693	904	513	522	949	121
184	511	468	989	746	437
772	988	731	243	653	426
749	559	856	334	428	953
256	127	302	669	456	674
258	323	925	142	532	329

[1] In the practical operations of arithmetic, skill in the fundamental processes is essential. The approximate degree of skill which should be attained by children of the various grades is now well known. If the children of a particular school have not attained this, the time given to the daily drill should be lengthened or the work should be made more intensive. If the children possess a higher degree of skill than that suggested, it is probable that more consideration should be given to thought processes, and less to drill. Problems given for tests should be used for that purpose only.

[2] Late in the spring the pupils of a strong sixth grade should average 4.5 correct solutions and 8 attempts. The pupils of a strong seventh grade should average 5.5 correct solutions and 9 attempts. The pupils of a strong eighth-grade class should average 6.5 correct solutions and 10.5 attempts. (Problems not completed are not counted as attempts.)

(13)	(14)	(15)	(16)	(17)	(18)
421	258	326	267	873	622
988	885	770	854	168	479
465	600	753	684	332	283
114	874	199	358	419	791
676	726	469	938	934	808
729	142	643	333	493	253
235	355	698	493	529	419
190	947	186	775	156	952
406	351	173	239	224	522

(19)	(20)	(21)	(22)	(23)	(24)
485	172	236	537	648	584
871	426	578	227	396	157
524	951	877	725	389	617
919	537	916	598	374	624
722	989	543	906	859	467
456	565	593	763	191	369
216	230	956	195	423	511
862	673	439	480	849	245
424	258	309	102	342	233

6. Practice in Subtraction

Subtraction by addition is easily taught by use of the following method:

$\begin{array}{r}15\\ \underline{-8}\\ 7\end{array}$ should be read 8 and 7 are 15; $\begin{array}{r}57\\ \underline{-19}\\ 38\end{array}$ should be read 9 and 8 are 17 and 2 and 3 are 5. In the process of subtraction the difference is thought of as the second addend in the process of addition and the minuend is the sum of the two addends.

(With pencil)

1. Solve the following problems by the addition process:

(1)	(2)	(3)	(4)	(5)
364	463	361	2864	9842
−122	−124	−264	−1781	−4684

(6)	3642	(7)	361	(8)	8000	(9)	\$1364	(10)	6372
	−1413		−189		−1463		−136		−2843

2. Out of a total of 9506 apples of the Gano variety 2985 were windfalls. How many apples were picked?

3. The following are weights of 8 steers, respectively, after and before a feeding test. How much did each gain?

No. 1	1260 lb.	No. 2	1185 lb.	No. 3	1190 lb.	No. 4	1225 lb.
	922 "		840 "		845 "		910 "
No. 5.	1212 lb.	No. 6	1242 lb.	No. 7	1197 lb.	No. 8	1280 lb.
	916 "		895 "		872 "		915 "

4. Solve the following problems as rapidly as you can:

(1)	82463	(2)	36210	(3)	9276	(4)	78643
	−14325		−18175		−4169		−7294
(5)	5432	(6)	7325	(7)	52364	(8)	96275
	−5291		−7086		−50475		−36094

7. Subtraction Test

1. Solve as many of the following problems as you can in four minutes: [1]

(1)	114957187	(2)	94752808	(3)	106089449
	−90271797		−67349640		−16915390
(4)	99833978	(5)	115171700	(6)	82484740
	−73160227		−63087381		−48207825

[1] The pupils of a strong sixth grade should average 6.2 correct solutions and 8.9 attempts; those of a strong seventh grade should average 7.3 correct solutions and 10 attempts; those of a strong eighth grade or of the high school should average 8.6 correct solutions and 11.7 attempts.

(7)	115916913 −55536329	(8)	72229470 −45049173	(9)	146246252 −52160891
(10)	80630266 −68164329	(11)	124485018 −73098624	(12)	107419373 −65348405
(13)	37953635 −23913884	(14)	137825921 −62729490	(15)	152695030 −85612816
(16)	178976226 −93060303	(17)	97089301 −20203267	(18)	93994413 −54783938
(19)	108051861 −73463849	(20)	163130569 −91061255	(21)	168354186 −70537861
(22)	188545364 −92471259	(23)	120981427 −64188045	(24)	105755782 −90863147

MULTIPLICATION AND DIVISION[1]

8. Practice in Multiplication

Good form in multiplication is an aid to clear thinking and accurate figuring.

Example: At 6¢ each what do 9 oranges cost? The following solutions if properly interpreted are correct: 6¢ × 9 = 54¢ or 9 × 6¢ = 54¢; or 9 × 6 = 54; therefore, the oranges cost 54¢. Since the multiplier indicates the number of times the multiplicand is to be taken, it is evident that the multiplier must always be abstract. 6¢ × 9 = 54¢ should be read 6¢ multiplied by 9 equals 54¢. 9 × 6¢ = 54¢ should be read 9 times 6¢ equals 54¢. 9 × 6 = 54 should be read, the cost of the oranges in cents equals in amount the product of 9 and 6, or 54¢.

[1] It must be borne in mind that multiplication and division are supplemental processes. They should be learned at the same time. 3 times 4 are 12, and $\frac{1}{3}$ of 12 is 4, are closely correlated conclusions. As in addition and subtraction there must be constant drill both in the concrete and in the abstract work. Only when these processes have become automatic is the maximum amount of mental energy released for the reasoning processes.

1. Find the cost of 12 doz. eggs at 36¢ per dozen. Find the cost of a 1260 lb. steer at 5¢ per pound.

Convenience will justify the following forms for the solution of these problems:

$$\begin{array}{r} 36\text{¢} \\ 12 \\ \hline \$4.32 \end{array} \qquad \begin{array}{r} 1260 \\ \$.05 \\ \hline \$63.00 \end{array}$$

The second problem may be analyzed as follows: the cost of the steer equals 1260 times \$.05 or \$63.00.

2. Find the cost of 79 A. of land at \$200 per acre.

It is evident that since the multiplier simply represents the number of times that the multiplicand is to be taken, its location in reference to the multiplicand is merely a matter of convenience. For example, either of the following forms may be used:

$$\begin{array}{r} \$200 \\ 79 \\ \hline 1800 \\ 1400 \\ \hline \$15800 \end{array} \qquad \begin{array}{l} 79 \\ 200 \\ \hline 15800 \therefore \$15800 \end{array}$$

The first of these processes is the better form, the second is often more convenient. ∴, followed by the denomination, is used only when it is necessary to explain the process.

(With pencil)

3. Find the cost of 1600 bu. of corn at 62¢ per bushel.

4. What is the total weight in pounds of 84 tons of hay?

5. During the month of January, 1913, a Missouri farmer sold 36 doz. eggs at 35¢ per dozen, 14 lb. of butter at 30¢ per pound, and 42 lb. of chicken at 16¢ per pound. How much did he receive for his produce?

6. A Tennessee farmer hired a man to build 620 rd. of woven-wire fence. He paid 13¢ per rod for having the fence built. What did the labor on the fence cost?

7. During the canning season Mrs. Neighbor used 198 lb. of sugar. The average cost of the sugar was 5.2¢ per pound. What did the sugar cost?

8. Mr. James employed 19 children to pick strawberries. The children picked on an average 43 qt. per day and were paid 2¢ per quart for their labor. How much did all the children earn each day? How much did all of the children earn in nine days?

9. Ease in multiplication depends upon one's ability to use short methods.

Example: $10 \times 18 = 180$ (found by annexing a cipher to 18). $20 \times 18 = 2 \times 18$, with a cipher annexed. $33\frac{1}{3} \times 15 = 500$ (found as follows: $\frac{15 \times 100}{3} = 500$).

(Without pencil)

10. Multiply the following numbers by 10; by 20; by 40; by 50: 13, 19, 29, 34, 49, 55, 59, 69, 73, 89, 97, 99.

11. Determine a short way of multiplying 24 by the following numbers: $33\frac{1}{3}$, $16\frac{2}{3}$, 50, 25, $12\frac{1}{2}$.

12. Find the cost of 36 lb. of butter at $33\frac{1}{3}$¢ per pound.
(Use a short method.)

13. An Ohio farmer sold 324 lb. of dressed chicken to a local butcher at $16\frac{2}{3}$¢ per pound. How much did he receive?

14. A farmer purchased 840 trees at $12\frac{1}{2}$¢ each. What did the trees cost?

15. What is the market value of 8 steers averaging 1045 lb., if they are worth 8¢ per pound?

(With pencil)

16. A train of 30 cars is loaded with coal. If the average amount of coal per car is 78,000 lb., how much coal is on the train?

17. A farmer gathered 22 loads of corn averaging 1840 lb. per load. How many pounds of corn did he haul in the 22 loads?

18. Solve the following problems as quickly as you can:

(1)	(2)	(3)	(4)
36942	7827	3724	9654
×234	×5435	×4682	×1234

(5) 8227	(6) 986421	(7) 56832	(8) 7112
×5436	×3642	×365	×2117
(9) 1928	(10) 3682	(11) 42861	(12) 5678
×4567	×2683	×3654	×9765

9. Multiplication Test

Work as many of the following problems as you can in six minutes: [1]

(1) 8259	(2) 3467	(3) 4637	(4) 2859	(5) 7436
28	93	82	47	65
(6) 5289	(7) 6473	(8) 8529	(9) 8632	(10) 5947
39	740	56	206	62
(11) 3268	(12) 4795	(13) 7954	(14) 2386	(15) 9745
95	83	74	38	59
(16) 6283	(17) 9624	(18) 7853	(19) 4926	(20) 5873
47	503	35	620	49
(21) 2964	(22) 8357	(23) 6249	(24) 3785	(25) 4965
94	87	78	35	19
(26) 8246	(27) 3597	(28) 5739	(29) 2648	(30) 9537
29	73	85	92	92
(31) 4268	(32) 7593	(33) 6428	(34) 8563	(35) 2947
37	640	58	207	63

[1] The pupils of a strong sixth grade should average 4.6 correct solutions and 7.1 attempts. Those of a strong seventh grade should average 5.3 correct solutions and 8.6 attempts. Those of a strong eighth grade should average 6.5 correct solutions and 9.8 attempts.

10. Practice in Division

Example: 16 loads of coal weighed 67456 lb. What was the average weight per load?

```
     4216 lb.
 16)67456 lb.
    64
     34
     32
      25
      16
       96
       96
```

The form used above is desirable, since it occupies less space than other forms and because it supplies a mechanical device for locating the decimal point, when needed. This is shown later in the division of decimals.

Use the above form in solving the following problems:

1. A farmer received the following weights for 8 loads of corn delivered at an elevator; 1860 lb., 2142 lb., 2130 lb., 1986 lb., 2049 lb., 2218 lb., 2245 lb., 2285 lb. What was the average amount per load? What was the average number of bushels per load?
(70 lb. of ear corn per bu.)

2. A calf sold at 12¢ per pound brought $14.76. How much did it weigh?

3. Twenty-one men each received $1.50 per day. At the end of a certain period their total wages amounted to $567. How many days had they worked?

4. The total weight of 27 steers was 30456 lb. What was their average weight?

5. A herd of 21 Holstein cows produced 6969 lb. of milk in one week. What amount did an average cow produce daily?

6. Solve the following problems as quickly as you can:

(1) $8\overline{)2728}$	(2) $12\overline{)5472}$	(3) $9\overline{)50589}$
(4) $21\overline{)14091}$	(5) $18\overline{)2556}$	(6) $14\overline{)19276}$
(7) $35\overline{)840}$	(8) $49\overline{)5929}$	(9) $65\overline{)8060}$
(10) $32\overline{)11104}$	(11) $26\overline{)21892}$	(12) $17\overline{)7412}$

7. The annual milk yield of each cow in a herd of 13 cows was as follows: 3240 lb., 6248 lb., 4236 lb., 5362 lb., 3246 lb., 6428 lb., 5283 lb., 6428 lb., 5491 lb., 6342 lb., 5624 lb., 4283 lb., and 4286 lb. Determine the average yield.

11. Prime Numbers

A prime number is one which is not exactly divisible by any number except itself and one. 1, 3, 5, 7, 11, 13, 17, etc., are prime numbers.

Example: $2 \times 3 = 6$; $3 \times 3 = 9$; $9 \times 6 = 54$; 2 and 3 are factors of 6; 3 and 3 are factors of 9; 9 and 6 are factors of 54. Which of these factors are prime numbers? Which are composite numbers? (A composite number is one which is exactly divisible by a whole number other than itself and unity.)

1. Name the prime factors of the following numbers: 6, 9, 18, 27, 32, 36, 42, 48, 66, 72, 100, 342, 500, 980, 1000, 4860.

2. Give two integral divisors of 6, 18, 27, 32, 42, 48, 66 and 99.

3. During the month of December, 1913, a man purchased 18 doz. eggs from a grocer at an average price of 36¢ per dozen. One ninth of the eggs was spoiled. How many eggs were spoiled? What did the good eggs cost per dozen?

4. A steer which sold at 5¢ per pound brought \$60. How much did it weigh?

5. A dairyman who sold milk at 16¢ per gallon received $129.60 for milk during the month of July. How many quarts of milk did he sell?

6. A farmer who delivered shelled corn to an elevator was credited with the following weights net: 2520 lb., 2480 lb., 2560 lb., 2300 lb., 2290 lb., 2384 lb., 2400 lb., 2483 lb., 2624 lb., and 2436 lb. At 56 lb. per bushel how many bushels of shelled corn did he sell? The corn sold for 62¢ per bushel. What amount was received for it?

12. Division Tests

Solve as many of the following problems as you can in eight minutes: [1]

(1) $24\overline{)6984}$	(2) $95\overline{)85880}$	(3) $36\overline{)10440}$	(4) $87\overline{)81867}$
(5) $78\overline{)62868}$	(6) $42\overline{)17682}$	(7) $63\overline{)26460}$	(8) $59\overline{)50799}$
(9) $36\overline{)16236}$	(10) $87\overline{)61161}$	(11) $95\overline{)69350}$	(12) $24\overline{)10800}$
(13) $63\overline{)42903}$	(14) $42\overline{)28560}$	(15) $29\overline{)29913}$	(16) $78\overline{)44538}$
(17) $29\overline{)24679}$	(18) $57\overline{)51642}$	(19) $38\overline{)32300}$	(20) $64\overline{)61504}$
(21) $46\overline{)34086}$	(22) $75\overline{)55500}$	(23) $92\overline{)27784}$	(24) $83\overline{)26643}$

13. Miscellaneous Problems

1. An average daily ration for a cow producing milk is 10 lb. of grain, 10 lb. of hay and 30 lb. of silage. How much of each ration is needed to feed such a cow for 30 days?

2. How long will 150 lb. of the above feed supply a cow producing milk? How much of each feed is needed to make the 150 lb. of feed?

[1] A strong sixth grade should average 4.2 correct solutions and 5.9 attempts; a strong seventh grade should average 5.2 correct solutions and 7.5 attempts; a strong eighth grade should average 7 correct solutions and 8.2 attempts.

3. The following mixture is considered a good mash for laying hens: wheat bran, 10 lb.; wheat middlings, 20 lb.; corn meal, 20 lb.; ground oats, 30 lb.; beef scrap, 25 lb.; and salt, $\frac{1}{2}$ lb. Determine the amount of each feed needed to make 2110 lb. of the mash.

4. A nursery company shipped 1200 Christmas trees to Chicago and sold them at 75¢ each. How much was received for the trees?

5. The following is a report for one year of 10 cows which were kept on a farm at McLean, Illinois:

TABLE 4

No. of cows	Amount of milk (lb.)	Amount of fat per 100 lb. of milk (lb.)	Value of butter-fat	Cost of feed
1......	5738	4.26	$85.75	$65.24
2......	6818	4.57	109.20	67.20
3......	6361	4.29	95.55	65.37
4......	3042	4.30	45.85	28.26
5......	7719	4.85	131.25	70.26
6......	5520	5.30	102.20	62.00
7......	4509	3.63	57.40	56.36
8......	7407	4.32	122.00	71.00
9......	4434	4.89	75.95	46.28
10......	5929	5.98	107.45	63.00

6. How many lb. of milk did the 10 cows yield in one year?

7. Estimating milk at $8\frac{1}{2}$ lb. per gallon, how many gallons of milk did the 10 cows produce in one year?

8. If this milk had been retailed at 10¢ per quart, what would have been the gross income from it?

9. Determine the average gross income from each cow, if the milk was worth 10¢ per quart.

10. Compute the value of the entire amount of butter-fat produced. (See column 4 in the above table.)

11. What was the total cost of the feed consumed by these cows? (See column 5 of the table.)

12. What was the net gain on the 10 cows, based on the value of the butter-fat?

13. What was the average net gain per cow?

Optional Problems

14. Butter averages about 82 lb. of butter-fat per 100 lb. of butter. Determine the number of pounds of butter that the fat yielded by the 10 cows would produce.

15. What was the value of the butter-fat per pound?

16. At this rate for butter-fat, what was the value of the butter if it contained 82 pounds of butter-fat per 100 pounds of butter?

17. Cows represented by numbers 1, 2, 6, 7, and 10 in the table above were Jerseys, and the rest of the herd were Guernseys. Determine the average production of each breed.

18. Determine the average number of pounds of butter-fat per 100 lb. of milk produced by each breed.

19. What was the average value per cow of the product of each breed?

20. What was the total butter yield of each breed of cows?

21. If butter was worth 40¢ per pound, what was the gross income from each breed of cows? What was the average income per cow for each breed?

22. Estimating the value of the cows reported in Table 4 at $100 each, how much did the value of the butter-fat exceed the cost of feed and interest on the investment in the cattle, provided this money was worth $6 per cow?

On two of the fields of the Illinois Experiment Station series of experiments covering three years were conducted to determine the relative value of drilling and broadcasting oats. The following table shows the results of the test:

TABLE 5

URBANA FIELD

Yield in bushels per acre

Plot No.	1st year		2d year		3d year	
	Drilled (bu.)	Broadcast (bu.)	Drilled (bu.)	Broadcast (bu.)	Drilled (bu.)	Broadcast (bu.)
1	56	48	67	52	48	40
2	43	39	28	27	30	28
3	63	51	37	33	36	23
4	59	47	34	32	28	31
5	68	56	34	35	35	31
6	71	50	35	34	27	26
7	63	48	30	29	29	25
8	56	40	31	35	33	36
9	53	48	26	30	32	30
10	57	47	33	32	30	30
11	53	48	26	30	30	30
12	58	47	27	28	25	27
13	62	56	36	33	31	27
14	61	45	33	28	25	28
15	62	53	32	30	19	30
16	67	56	33	33	28	27
17	75	52	30	30	19	16
18	71	53	30	29	16	17

DEKALB FIELD

Yield in bushels per acre

Plot No.	1st year		2d year		3d year	
	Drilled (bu)	Broadcast (bu.)	Drilled (bu.)	Broadcast (bu.)	Drilled (bu.)	Broadcast (bu.)
1	19	18	26	23	36	32
2	16	14	28	27	28	37
3	16	16	32	31	39	37
4	21	19	28	30	43	35
5	29	24	30	26	33	45
6	26	21	30	24	51	38
7	27	24	38	25	47	54
8	21	22	35	25	42	37
9	32	17	30	27	43	43
10	27	18	33	32	34	40

23. How much did the drilled oats exceed the broadcasted oats per acre for the three years on plot 1 in each field?

24. What was the average gain per acre for the three years on plot 1 in each field?

25. On the basis of the average gain per acre for both fields, what would have been the gain of the drilled oats over the broadcasted oats on 50 acres?

26. If oats averaged 40¢ per bushel for the three years, what would have been the gross income from 50 acres of drilled oats? From 50 acres of broadcasted oats (based upon average yield of both fields)?

27. Determine the average yield of oats on all of the plots in the Urbana Field in the first year for both the drilled and the broadcasted plots. What was the difference in the average of the two yields for that year?

28. In like manner determine the average yield on all of the plots for the three years on the Urbana Field.

29. Determine the average yield for drilled oats and for broadcasted oats for the three years on the DeKalb Field.

CHAPTER II. DENOMINATE NUMBERS

TABLE 6

14. Long or Linear Measure

Common Linear Measure

12	inches (in.)	= 1 foot (ft.)
3	feet	= 1 yard (yd.)
5.5	yards	= 1 rod (rd.)
16.5	feet	= 1 rod
320	rods	= 1 mile (mi.)

Surveyor's Measure

7.92	inches	= 1 link (li.)
100	links	= 1 chain (ch.)
80	chains	= 1 mile (mi.)
1.15	common mi.	= 1 geographical or nautical mile

(Without pencil)

1. How many feet are there in one mile?

2. How many yards are there in one mile?

3. How many posts placed 1 rd. apart are needed for 320 rd. of fence?

4. How many rods are there in one chain?

(With pencil)

5. What will it cost to build one mile of fence if the posts and wire cost 36¢ per rod and the labor costs 10¢ per rod?

6. A surveyor found the north line of a certain farm to be 37 chains and 49 links. What was the length of this north line in rods and feet?

7. An Indiana farmer built a fence around the northwest quarter of a section of land. How many rods of fence did he build? [1]

[1] This estimate should take into account one half of a 40-ft. road on the north and west sides of the farm. A section of land is normally one mile square.

8. Determine the cost of fencing the farm referred to in problem 7 with a 39-in. woven-wire fence, including a single strand of barbed wire on top, the wire to be supported by cedar posts 12 feet apart, costing 22¢ each. Thirty-nine-inch woven wire is valued at 32¢ per rod, and barbed wire at $2.50 per spool of 80 rods. The labor of building the fence costs 12¢ per rod.

9. Determine the cost of laying 80 rods of 6-in. tile, if tile cost $3.50 per hundred feet, and the expense of laying the tile is 60¢ per rod. Each tile is 14 in. long.

TABLE 7

15. Surface Measure

144 square inches (sq. in.)	= 1 square foot (sq. ft.)
9 square feet	= 1 square yard (sq. yd.)
$30\frac{1}{4}$ square yards	= 1 square rod (sq. rd.)
160 square rods	= 1 acre
10 square chains	= 1 acre
640 acres	= 1 square mile (sq. mi.)

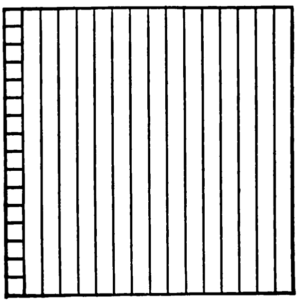

FIGURE 1

(Without pencil)

1. How many square inches are there in a strip 1 ft. long and 1 in. wide? How many such strips are there in 1 sq. ft.? Show how many square inches there are in 1 sq. ft.

2. The "Rag Doll" method of testing seed corn consists in marking rectangular strips of muslin off into squares and placing one or more grains of seed in each square. The cloth is then rolled up and moistened. In due time the grains are examined for sprouts. How many grains of corn can be tested on a strip of muslin $1\frac{1}{2}$ ft. by 3 ft. if the strip is marked into 2-in. squares and a strip 1 in. wide is left on each edge for folding?

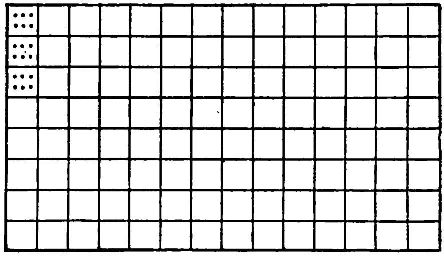

FIGURE 2

Six grains taken from a single ear are usually placed in each square.

3. Find two numbers which multiplied together will give 160 as a product. What other whole numbers will give the same product?

4. What is the length of each side of the northwest quarter of the northeast quarter of a section of land?

A section is considered here to be one mile square. (See Fig. 3.)

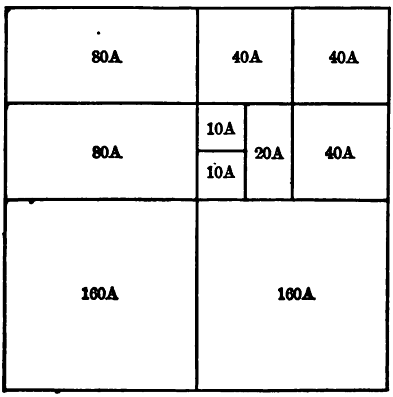

FIGURE 3

5. If a tract of land is 40 rd. long, how wide will it need be to contain 160 sq. rd.? If a tract of land is 20 rd. long, how wide will it need be to contain 160 sq. rd.?

6. How wide a strip will one need to plow on one side of a square 40-acre field in order to plow 1 acre?

(With pencil)

7. If by means of a gang plow one plows, in the field mentioned in problem 6, a strip 10 rd. wide in 1 day, how many acres does he plow?

8. If a rectangular tract of land is 40 chains long and 21 chains wide, how many acres are there in it?

TABLE 8

16. Cubic Measure

1728 cubic inches (cu. in.)	= 1 cubic foot (cu. ft.)
27 cubic feet	= 1 cubic yard (cu. yd.)

(Without pencil)

1. How many square feet are there in one face of a cubic yard? If a section 1 ft. deep is cut from the top of a cubic yard, how many cubic feet will the section contain? How many such sections are there in a cubic yard? How many cubic feet are there in a cubic yard?

2. How many cubic yards of sand are delivered in 5 loads, each load containing 30 cu. ft.?

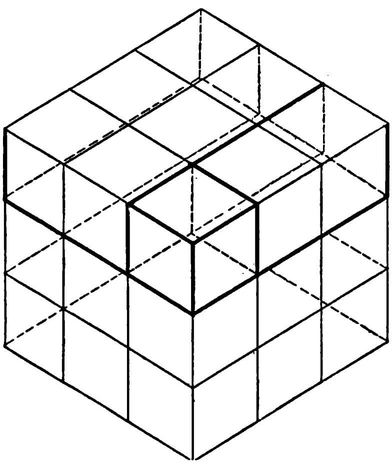

FIGURE 4

3. What is the capacity in cubic feet of a rectangular tank whose dimensions are 10 ft. by 5 ft. by 3 ft.?

(With pencil)

4. How many gallons of water will the tank, referred to in problem 3, hold?

(1 gal. contains 231 cu. in.)

5. How many bushels of shelled corn will a granary 10 ft. by 8 ft. by 6 ft. contain?

(A bushel of shelled corn occupies approximately $2150\frac{1}{2}$ cu. in. of space.)

6. How many bushels of shelled corn can be placed in a double box-wagon bed, the dimensions of which are 3 ft. by 10 ft. by $2\frac{1}{2}$ ft?

7. Determine the number of cubic yards of dirt that would be removed in excavating for a cellar 12 ft. by 18 ft. by 8 ft.

8. If a steam dredge removes 3 cu. yd. of dirt every minute during a working day of 10 hr., how long a drainage ditch will this dredge dig in 30 days if the ditch is dug 20 ft. wide and 8 ft. deep?

TABLE 9

17. Avoirdupois Weight

16 ounces (oz.)	=	1 pound (lb.)
100 pounds	=	1 hundredweight (cwt.)
2000 pounds	=	1 ton (T)

(With pencil)

1. Find the cost of 1760 lb. of bran at $1.25 per cwt.?

2. Determine the cost of 4600 lb. of coal at $3.26 per ton.

3. Determine the freight on 30 tons of coal at $7\frac{1}{2}$¢ per cwt.

4. Twenty young chickens when weighed in groups of 4 each, totaled the following weights per group: 7 lb., 7 oz.; 6 lb., 5 oz.; 6 lb., 9 oz.; 7 lb., 10 oz.; 5 lb., 14 oz. What was the aggregate weight of all?

5. How much was realized on these chickens if they sold for 22¢ per lb.?

6. How many tons of coal may be loaded on a car without the shipper being penalized if the car has a capacity of 80,000 pounds?

7. When the freight rate is 4¢ per cwt. upon grain, what is the cost per bushel for shipping wheat?

(60 lb. in a bushel.)

8. If a local dealer buys wheat, f.o.b. at 80¢ per bushel, and sells it in the car at the other end of the line for 87¢ per bushel, how much does he clear per bushel? [1]

TABLE 10

18. Liquid Measure

2 pints (pt.)	= 1 quart (qt.)
4 quarts	= 1 gallon (gal.)
1 gallon	= 32 gills, 8 pints, 4 quarts, or 231 cubic inches.

(Without pencil)

1. A dairyman retails 116 qt. of milk per day. If he sells 12 qt. for $1, how much is his daily income?

2. A farmer's wife filled 78 qt. jars with large fruit and 56 pt. jars with small fruit. How many gallons of canned fruit had she?

(With pencil)

3. A bushel of peaches costing $1.75 in the market produced 20 qt. of canned fruit. 12 lb. of sugar, which cost at the rate of $1 for 18 lb. were used. The labor and fuel were worth $1.25 and the jars cost 90¢ per dozen. What was the cost of preparing this fruit per quart?

4. How much water will a tank hold which is 10 ft. long, 48 in. wide and 2 ft. deep?

[1] In shipping, the term "hundredweight" is now commonly abbreviated to "hundred"; "f.o.b." means "free on board" (on the car) at the place of shipment.

TABLE 11

19. Dry Measure

2 pints (pt.)	= 1 quart (qt.)
24 quarts	= 1 crate (cr.)
8 quarts	= 1 peck (pk.)
4 pecks	= 1 bushel (bu.)
1 bushel	= 64 pints, 32 quarts, 4 pecks, 2150.42 cubic inches, 60 pounds of wheat, 56 pounds of shelled corn, 70 pounds ear corn.

(With pencil)

1. Twenty children picked a total of 800 qt. of strawberries per day. How many crates did they pick? How many bushels?

2. How much did these berries bring per quart if they sold for $3 per crate?

3. A truck farmer raised 800 cr. of berries which he sold for $2.50 per crate. How much did he receive for the berries?

4. What do cherries cost per quart which are purchased at $1.80 per bushel?

5. A truck farmer sold 360 cr. of strawberries at $3.25 per crate. How many quarts did he sell? How many bushels? How much did he receive per quart? Per bushel?

6. A wagon loaded with ear corn weighed 4045 lb. After the corn was unloaded the empty wagon weighed 1200 lb. How many bushels of corn were in the load?

7. The same wagon loaded with shelled corn weighed 4145 lb. How many bushels of corn were in the load?

8. How many bushels of shelled corn may be placed on a car of 40,000 lb. capacity?

TABLE 12

20. Counting

12 things = 1 dozen (doz.)
20 things = 1 score
12 dozen = 1 gross

(With pencil)

1. If each child in a school of 400 children uses on an average 2 pens per month for the school year of 9 months, how many gross will be needed to supply this school for this period?

2. Good pens are quoted at about 30¢ per gross, net, to the purchaser. What will it cost to supply pens for this school of 400 children for 1 school year of 9 months?

3. If the children should purchase these pens from a local dealer for a cent each, what would the pens cost?

4. How much does a dealer make on a gross of pens if he sells them for one cent each?

5. A school bought 50 gross of pencils for $144. How much did each pencil cost?

6. How much will 50 gross of pencils cost the children if they purchase them from a local dealer at 5¢ each?

7. How much does the local dealer make upon the transaction?

TABLE 13

21. Paper Measure

24 sheets = 1 quire
20 quires = 1 ream[1]

1. How many sheets of paper are there in one ream?

[1] Paper-supply houses usually give 500 sheets to the ream.

(With pencil)

2. If a dealer buys school paper for 38¢ per ream and sells it 6 sheets for 5¢, how much does he clear per ream?

3. A school officer purchased paper for the schools at 35¢ per ream, net. If the children got the paper at cost, how many sheets did they receive for a cent?

4. A local dealer contracted with a school officer to supply all of the paper needed by the schools on a commission of one tenth of the cost. He received 5¢ per ream for his services. How much did he claim the paper cost?

5. On investigation it was found that he purchased the paper from a paper concern for 38¢ per ream. He had bought 100 reams for each of six years. How much money should he be required to return to the school authorities?

6. The same dealer received 4¢ per gross for purchasing pens which he reported cost 40¢ per gross. An investigation revealed the fact that the pens had been purchased for 29¢ per gross. How much should he refund to the school officer on a purchase of 120 gross of pens?

CHAPTER III. COMMON FRACTIONS

22. Reduction of Common Fractions

(Without pencil)

1. Compare the following fractions: $\frac{1}{2}$; $\frac{3}{6}$; $\frac{6}{12}$; $\frac{12}{24}$; $\frac{24}{48}$; $\frac{48}{96}$, and note in what particular they are alike.

2. Determine the process that is necessary to change the form of each of the above fractions to the form immediately following it.

3. Determine the process required to change the form of each of the last five fractions in problem 1 to the form immediately preceding it.

4. State clearly the process required to change the form of a common fraction without altering its value.

5. Change the following fractions to fractions of different form but of equal value: $\frac{7}{21}$, $\frac{9}{27}$, $\frac{35}{70}$, $\frac{12}{18}$, $\frac{15}{25}$.

A common fraction is in its lowest denomination when the numerator and denominator do not have a common factor other than unity. $\frac{3}{6}$ is not in its lowest terms, since 3 is a factor of both 3 and 6. $\frac{3}{4}$ is in its lowest terms, since 3 and 4 have not a common factor.

ADDITION AND SUBTRACTION OF COMMON FRACTIONS

23. Practice in finding a Common Denominator

Common experience leads us to know that we cannot add unlike units. No one can add "nickels" and "dimes." If he wishes to add the sums of money that they represent, he must either think of the dimes in terms of nickels or of the nickels in terms of dimes, or, as is more usual, he must think of both in terms of "cents." In like manner if one wishes to add two or more quantities he must reduce them in thought to a common unit. Common fractions are no exception to this principle. $\frac{1}{4}$ and $\frac{1}{2}$ cannot be added until they are reduced to a common unit or denomination. It is more convenient to think of them in

terms of the smaller unit (fourths). A common unit with fractions means a common denominator. An understanding of the process of reducing two or more fractions to a common denominator is necessary in order to add and subtract them.

(Without pencil)

1. Change each of the following fractions to another fraction of equal value: $\frac{1}{3}$, $\frac{1}{5}$, $\frac{1}{7}$, $\frac{1}{4}$, $\frac{1}{6}$, $\frac{1}{10}$.

2. How many fourths are there in $\frac{1}{2}$?

3. How many eighths are there in $\frac{1}{2}$? How many eighths are there in $\frac{1}{4}$?

4. Give two ways of adding $\frac{1}{2}$ and $\frac{1}{4}$.

5. In which process is the smaller common denominator used?

NOTE: 8 is a common denominator of the fractions $\frac{1}{2}$ and $\frac{1}{4}$. 4 is the least common denominator of $\frac{1}{2}$ and $\frac{1}{4}$.

6. Find by inspection a common denominator of the following fractions: $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{6}$. Explain how the result was obtained. Find their least common denominator.[1]

7. Find the sum of $\frac{1}{4}$, $\frac{1}{3}$, and $\frac{1}{6}$.

24. Practice in finding the Least Common Denominator

A prime factor is one which is not divisible without a remainder, by any whole number except itself and unity.

The Least Common Multiple of two or more numbers is the product obtained by taking each prime factor of the given numbers the greatest number of times it occurs in any of the given numbers.

$$12 = 2 \times 2 \times 3$$
$$16 = 2 \times 2 \times 2 \times 2$$
$$20 = 2 \times 2 \times 5$$
$$24 = 2 \times 2 \times 2 \times 3$$

[1] Since the Least Common Denominator of two or more fractions is the same as the Least Common Multiple of the denominators of those fractions, it is important that the process of finding the Least Common Multiple of two or more numbers be understood.

2 occurs four times as a factor of 16 and consequently should be taken four times as a factor in determining the Least Common Multiple; 3 is not used more than once as a factor of any one of these numbers, nor is 5. The factors to be used, therefore, are $2 \times 2 \times 2 \times 2 \times 3 \times 5$ and the Least Common Multiple is 240. The process of finding the Least Common Multiple is shortened by eliminating those numbers which are factors of larger numbers. Since 12 is a factor of 24 it need not be factored.

1. Find the common denominator of the following fractions: $\frac{1}{4}$, $\frac{1}{6}$, $\frac{1}{10}$, $\frac{1}{24}$, $\frac{1}{36}$.

Two Forms

Form (1)

$$
\begin{array}{r|rrrrr}
2 & \frac{1}{4}, & \frac{1}{6}, & \frac{1}{10}, & \frac{1}{24}, & \frac{1}{36} \\
\times & & & & & \\ \hline
2 & 2, & 3, & 5, & 12, & 18 \\
\times & & & & & \\ \hline
3 & 1, & 3, & 5, & 6, & 9 \\ \hline
\end{array}
$$

$$\times \quad 1, \times 1, \times 5, \times 2, \times 3$$

$$2 \times 2 \times 3 \times 5 \times 2 \times 3 = 360$$

Form (2)

$$
\begin{aligned}
4 &= 2 \times 2 \\
6 &= 2 \times 3 \\
10 &= 2 \times 5 \\
24 &= 2 \times 2 \times 2 \times 3 \\
36 &= 2 \times 2 \times 3 \times 3
\end{aligned}
$$

$$2 \times 2 \times 2 \times 3 \times 3 \times 5 = 360$$

In form (1), the Least Common Denominator is determined by taking as a divisor any prime factor which will divide two or more of the denominators without a remainder. The quotients and the demoninators which are not divisible by the divisor are taken for the dividends of the next division. This process is repeated until no two dividends are divisible by a prime factor excepting unity. The product of the several divisors and the last remainders is the Least Common Denominator.

In form (2), each denominator is reduced to its prime factors. Each of these prime factors is taken as many times as it is a factor of the number in which it occurs as a factor the greatest number of times. The product of the factors taken is the Least Common Denominator.

(With pencil)

2. A boy weighed each of five apples and obtained the following results; $\frac{1}{3}$ lb., $\frac{1}{4}$ lb., $\frac{1}{2}$ lb., $\frac{1}{6}$ lb., and $\frac{1}{4}$ lb. How much did all of the apples weigh?

3. Add the following mixed numbers: $23\frac{3}{4}$, $42\frac{5}{8}$, $145\frac{1}{2}$, $24\frac{5}{6}$.

4. The chest expansion of ten boys in a certain school is as follows: $1\frac{3}{4}$ in., $1\frac{5}{8}$ in., $\frac{3}{4}$ in., $\frac{1}{2}$ in., $1\frac{7}{10}$ in., $1\frac{3}{4}$ in., 2 in., $1\frac{3}{4}$ in., $2\frac{2}{5}$ in., 2 in. What is the average chest expansion of these boys?

5. Solve the following problems:

(1) $\frac{1}{12} + \frac{3}{16} + \frac{3}{4} + \frac{5}{18} = ?$
(2) $\frac{4}{32} + \frac{9}{27} + \frac{40}{84} = ?$
(3) $\frac{40}{286} + \frac{3}{94} + \frac{7}{32} = ?$
(4) $\frac{8}{9} + \frac{3}{4} = ?$
(5) $\frac{21}{27} + \frac{2}{9} = ?$
(6) $\frac{27}{84} + \frac{2}{18} = ?$

25. Multiplication of Common Fractions

A fraction may be multiplied by a whole number as follows:

$$\frac{3}{10} \times 3 = \frac{9}{10};\quad \frac{3}{\cancel{12}_{4}} \times \cancel{3}^{1} = \frac{3}{4};\quad \frac{4}{\cancel{15}_{5}} \times \cancel{6}^{2} = \frac{8}{5} \text{ or } 1\frac{3}{5}.$$

1. From this example, form a rule for multiplying a fraction by a whole number.

(Without pencil)

2. Find answers to the following:

(1) $8 \times \frac{6}{18} = ?$ (2) $24 \times \frac{36}{48} = ?$ (3) $18 \times \frac{36}{72} = ?$
(4) $3 \times \frac{6}{21} = ?$ (5) $\frac{1}{2} \times 10 = ?$ (6) $\frac{7}{16} \times 4 = ?$
(7) $\frac{22}{36} \times 12 = ?$ (8) $\frac{1}{23} \times 46 = ?$

A fraction may be multiplied by a fraction as follows:

(1) $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$ (2) $\frac{3}{4} \times \frac{5}{7} = \frac{15}{28}$ (3) $\frac{\cancel{4}^{1}}{\cancel{12}_{\cancel{4}}} \times \frac{\cancel{3}^{1}}{6} = \frac{1}{6}$

3. From these examples, form a rule for multiplying one fraction by another.

4. A cubic foot of water contains about $7\frac{1}{2}$ gal. How many gallons of water are there in 24 cu. ft. of water?

5. What will $4\frac{1}{2}$ doz. eggs cost at 32¢ per dozen?

6. Determine the cost of 46 yd. of muslin at $12\frac{1}{4}$¢ per yard.

7. What is the cost of $8\frac{1}{2}$ ft. of hemp rope at $\frac{1}{2}$¢ per foot?

8. How many square feet are there in the surface of a flower bed $8\frac{1}{2}$ ft. by $3\frac{3}{4}$ ft.?

Solution: $8\frac{1}{2}$ ft. $= \frac{17}{2}$ ft; $3\frac{3}{4}$ ft. $= \frac{15}{4}$ ft. $\frac{17}{2} \times \frac{15}{4} = \frac{255}{8}$ or $31\frac{7}{8}$. There are $31\frac{7}{8}$ sq. ft. in the bed.

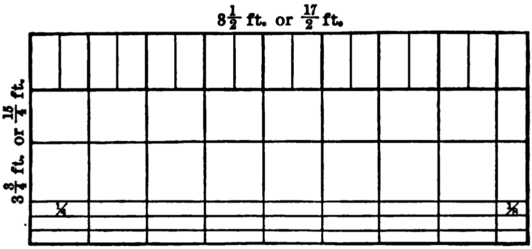

FIGURE 5

(With pencil)

9. Determine the area of a rectangular concrete basement $29\frac{7}{12}$ ft. long by $18\frac{1}{2}$ ft. wide.

10. Determine the area of a tract of land $90\frac{3}{4}$ rd. long, by $40\frac{5}{7}$ rd. wide.

11. Determine the number of square feet on the top surface of three boards each $9\frac{1}{2}$ in. wide and 12 ft. long.

12. Find the cost of 42 yd. of gingham at $12\frac{1}{2}$¢ per yd.

26. Division of Common Fractions

(Without pencil)

1. If $\frac{3}{4}$ of an apple is divided equally among 3 boys, what portion of the whole apple does each receive?

2. If $\frac{1}{3}$ of an apple is divided equally among 3 boys, what portion of the whole apple does each boy receive? If each third of the entire apple is divided into 3 equal parts, into how many parts will the apple be divided? What portion of all of these parts does each of the boys receive?

From the above problems we get the following results:

$$(1)\quad \tfrac{3}{4} \div 3 = \tfrac{1}{4}$$
$$(2)\quad \tfrac{1}{3} \div 3 = \tfrac{1}{9}$$

Determine by inspection how these results are obtained.

(Since 3 equals $\frac{3}{1}$ it is apparent that the results can be obtained as follows: $\frac{3}{4} \times \frac{1}{3} = \frac{1}{4}$; $\frac{1}{3} \times \frac{1}{3} = \frac{1}{9}$.)

From these examples, form a rule for dividing a fraction by a whole number or a fraction.

27. Partition and Measurement

In problem (1) each boy received $\frac{1}{3}$ of $\frac{3}{4}$ of an apple and in problem (2) each boy received $\frac{1}{3}$ of $\frac{1}{3}$ of an apple. One third of a quantity is found by dividing the quantity by 3. One third of a quantity is a very different result from the result obtained by dividing the quantity by $\frac{1}{3}$.

This distinction depends upon whether the divisor is considered a unit of measurement or whether it indicates the size of the parts into which the dividend is to be divided. For example:

$\frac{1}{3}$ of 3 ft. is 1 ft. (Partition.)
3 ft. $\div$ $\frac{1}{3}$ ft. $=$ 9 (Measurement.)

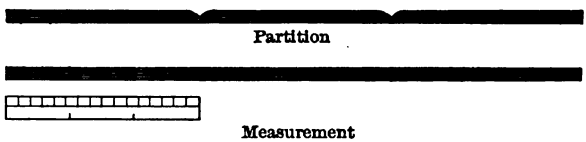

FIGURE 6

If 3 ft. are divided into 3 equal parts each part is 1 ft. long. If 3 ft. are measured (divided) by a $\frac{1}{3}$ ft. unit, the result is 9. That is $\frac{1}{3}$ ft. is contained in 3 ft. 9 times.

(Use pencil only when needed)

1. Form a rule for obtaining a fractional part of a number.

2. Form a rule for measuring a whole number by a fraction.

3. Determine which of the terms of a division are abstract and which are concrete in *partition* and in *measurement.*

4. If $\frac{3}{5}$ of an acre is divided into 2 equal lots, what is the area of each lot? (Partition or measurement?)

5. $\frac{1}{4}$ of a section of land was divided equally among three children. What portion of the section of land did each receive? How many acres did each receive?

6. Solve the following problems:

(1) $\frac{4}{5} \div 2 = ?$

(2) $\frac{9}{15} \div 24 = ?$

(3) $\frac{13}{23} \div 4 = ?$

(4) $\frac{1}{2} \div \frac{1}{4} = ?$

(5) $\frac{4}{5} \div \frac{1}{3} = ?$

(6) $\frac{12}{44} \div \frac{3}{11} = ?$

(7) $3\frac{3}{4}$ lb. $\div 2 = ?$

(8) 150 bu. $\div 6 = ?$

(9) $164\frac{2}{3}$ A. $\div 5 = ?$

Optional Problems

(With pencil)

7. A carload of hogs weighing 18,490 lb. brought $8\frac{1}{4}$¢ per lb. What was the value of the carload?

8. A cattle dealer purchased at the stock yards in Omaha, 40 head of steers averaging 790 pounds, at $4\frac{1}{2}$¢ per pound. What did these steers cost?

9. How many strips of sod $1\frac{3}{8}$ ft. wide are required to sod a piece of ground 11 feet wide?

10. A dealer buys pens for 28¢ per gross and sells them for $\frac{1}{2}$¢ each. How much does he clear per gross?

11. A family received 12 qt. milk tickets for a dollar. If 3 qt. of milk were used per day, what was the milk bill for the month of January?

12. Fifty boards $\frac{5}{16}$ of an inch thick were piled upon each other. How high was the pile?

13. A lumber rack is 5 ft. high. How many boards $\frac{3}{4}$ of an inch thick are piled upon each other in this rack?

CHAPTER IV. DECIMAL FRACTIONS

28. Reading and Writing Decimals

A decimal is read as a whole number and is given the name of its right-hand unit. The units to the right of the decimal point are *tenths*, *hundredths*, *thousandths*, etc.

Example: 3.24 is read 3 and 24 hundredths; 24.2678 is read 24 and 2678 ten-thousandths.

(Without pencil)

1. Read the following numbers:

(1)	.1	(9)	16.111	(17)	21.36200
(2)	.01	(10)	12.1111	(18)	3642.0361
(3)	.001	(11)	10.11111	(19)	362.42
(4)	.0001	(12)	18.111111	(20)	84.3621
(5)	.00001	(13)	36.21	(21)	2.3624
(6)	.000001	(14)	243.216	(22)	8.8601
(7)	2.1	(15)	1826.1826	(23)	632.32
(8)	24.11	(16)	1321.4230	(24)	32.3232

(With pencil)

2. Express the value of the following common fractions in decimal form:

(1)	$\frac{1}{10}$	(3)	$\frac{1}{1000}$	(5)	$\frac{1}{1000000}$	(7)	$\frac{1}{4}$	(9)	$\frac{25}{50}$
(2)	$\frac{1}{100}$	(4)	$\frac{1}{10000}$	(6)	$\frac{1}{2}$	(8)	$\frac{3}{4}$	(10)	$\frac{12}{24}$

Write as decimals:

3. 24 hundredths
4. 364 thousandths
5. 8642 hundred-thousandths
6. 42 tenths
7. 364 hundredths
8. 364 and 22 thousandths
9. 84 and 84 ten-thousandths
10. 86 millionths
11. 3421 and 364 hundred-thousandths

Write in columns for adding:

12. 364.236, 42.36, 421.4216, 801.108, 32.4614

13. 2.04, 3.462, 823.1, 5632.21, 82.0101, 3.2, .1, 12

14. 3621., 462.32, 6762.36, 4236.22, 36.36, 2.2

15. 42.1, 1.42, 36.24, 36., .36, 42.36, 1.1

29. Addition and Subtraction of Decimals

(With pencil)

Solve the following problems:

1. 8.36 + 246.1 + 364.212
2. 21.21 + 36.36 + 42.1
3. 364.2 + 2.364 + 8.8
4. 768.2 + 821.21 + 3621.1
5. 2.21 + 4.8 + 64.24 + 36.921
6. 3642.371 + 21.004 + 36.24
7. 21.212 + 3642.1 + 78.111 + 111.96
8. 364.2 + 78.364 + 36.42 + 36.781
9. 82.37 + 960.2 + 341.17 + 21.92 + 31.41
10. 4161.1671 + 9.27 + 3.001 + 1.0012
11. 8642.1 + 3.6721 + 42.362 − 8.756
12. 24.24 + 86.742 + 942. − .863
13. 4263.874 − 3621.52 + 632.842
14. 91.19 + 101.101 + 312.213 − 91. − .91
15. 6721 − .8234 − .7621 − 3.6241
16. .82 + .963 − .24 − .1876 − .01

17. 16 cows produced the following amounts of milk in one day: 24.6 lb., 32.9 lb., 21.64 lb., 35.21 lb., 39.26 lb., 24.4 lb., 33.24 lb.,

36.21 lb., 45.4 lb., 56.36 lb., 31.23 lb., 36 lb., 30 lb., 19.6 lb., 12.3 lb., and 17.6 lb.; how much milk did all together produce in the one day?

30. Multiplication of Decimals

$$\begin{array}{r} 24.1 \\ .21 \\ \hline 241 \\ 482 \\ \hline 5.061 \end{array} \qquad\qquad \begin{array}{r} 1.362 \\ 4.2 \\ \hline 2724 \\ 5448 \\ \hline 5.7204 \end{array}$$

From an examination of the above problems form a rule for finding the decimal places in the answer.

(With pencil)

Solve the following problems:

1. $36.21 \times .21$
2. $42.42 \times .16$
3. 86×4.6
4. 362.8×41
5. $8624 \times .16$
6. 3942×2.21
7. $864.75 \times .32$
8. $4632 \times .35$
9. $36.42 \times .12$
10. $8426 \times .7$
11. 2467.36×1.45
12. 1256.12×3.61

13. Find the value of a 1200 lb. steer at 8¢ per pound.

14. What will 2460 bu. of oats cost at 35¢ per bushel?

15. How much did a farmer get for his crop of 5628 bu. of corn, if he received 62¢ per bushel for it?

16. 16 tons of alfalfa hay were purchased at $18.45 per ton. What was the total cost of the hay?

17. A merchant purchased 840 gal. of gasoline at 9.24¢ per gallon. How much did he invest in gasoline?

18. A dairyman sold on an average 85 qt. of milk per day. If he received 8.5¢ per quart for it, what was his yearly income from the sale of milk?

31. Form in Division of Decimals

(With pencil)

1. A school janitor divided 472.65 lb. of modeling clay into cakes weighing 3.6 lb. each. How many cakes did he make?

```
         13 1.29
3.6∧)472.6∧50
     36
     112
     108
       46
       36
       105
        72
        330
        324
          6
```

The form given above should be used for two reasons: (1) It occupies less space than other forms; (2) It furnishes a mechanical device for locating the decimal point. The operator needs only to check the location of the decimal point on the base line of the quotient as shown above before beginning the operation. This check is placed as many places to the right of the decimal point in the dividend as there are decimal places in the divisor. It may be necessary to add ciphers to the dividend in order to accomplish this.

```
                          16 00.
.16)256            .16∧)256.00∧
                        16
                         96
                         96
```

2. How many ciphers should be added to the dividend of each of the following problems? Where should the (∧) be placed?

(Without pencil)

(1) 2.8)36421.   (2) .368)368.   (3) .25)1.

3. Locate the decimal point in the following problems without solving them, by means of the check:

(1) $36.4\overline{)562.0432}$ (2) $.56\overline{)36.426}$

(3) $.256\overline{)842.2}$ (4) $.21\overline{)426}$

(With pencil)

4. The following is the egg record of 22 hens for 10 days: 14, 17, 16, 15, 12, 19, 17, 12, 15, 16. What was the average number of eggs produced daily?

5. During these ten days, the cost of rations fed was as follows:

Meat scrap	$.18
Scratch feed	$.70
Corn	$.25

What was the average cost of food per egg?

6. The eggs referred to in problem 4 were sold for 20¢ per dozen. What was the net profit per egg? What was the average profit per hen for the 10-day period, labor not considered?

32. Practice in the Division of Decimals

Division of decimals is frequently difficult for pupils to master. It is suggested that the following list of problems be solved and supplementary lists be supplied until a high degree of skill is obtained.

(With pencil)

Divide:

1. 1 by .1; .1 by 1; 10 by .01; .01 by 10
2. 140.46 by 24
3. 24 by .48
4. 1070.76 by 12
5. 57.92 by .16

Solve:

6. $.8\overline{)2912.}$
7. $.12\overline{)14688.}$
8. $.12\overline{)4.3452}$
9. $1.5\overline{)213.15}$
10. $.7\overline{)25.368}$
11. $.27\overline{)1517.67}$

12. $.23\overline{)60.03}$ 15. $1.12\overline{)38.3152}$ 17. $1.52\overline{)5186.24}$

13. $.48\overline{)2046.288}$ 16. $12.4\overline{)5283.64}$ 18. $.175\overline{)597.1}$

14. $.65\overline{)275.015}$

Optional Problems

19. An estate valued at $36340.65 was divided equally among 18 heirs. How much did each receive?

20. How many pieces 2 in. thick by 4 in. wide and 12.8 in. long can be made from 10 two-by-four scantlings 16 ft. long?

21. The weights of 8 loads of ear corn were as follows: 1600.8 lb., 1846.44 lb., 1742.75 lb., 2140.86 lb., 1936.72 lb., 1818.12 lb., 1896.76 lb., 1848.36 lb. How many bushels were in the 8 loads? (Estimate the corn at 70 lb. per bushel.)

22. A carload consisting of 985 melons brought $95.60 net. What was the average price per melon?

23. A farmer sold 62.53 A. for $5337.50. How much did he get per acre for his land?

24. The annual taxes on 194.63 A. of land were $158.36. What were the annual taxes per acre upon this land?

PERCENTAGE

33. Principles of Percentage

(Without pencil)

1. Change the following fractions to equivalent fractions having 10 for their denominators: $\frac{1}{2}$, $\frac{1}{5}$, $\frac{2}{20}$, $\frac{8}{16}$, $\frac{40}{50}$, $\frac{7}{70}$, $\frac{40}{80}$.

2. Change each of the above common fractions to its equivalent decimal fraction.

3. Change each of the following decimal fractions to its equivalent common fraction: .5, .2, .1, .6, .8, .4.

4. Compare the values of the first three fractions in problem 3 with the corresponding fractions in problem 1.

(It should be observed that $\frac{2}{20}$ differs from .1 in form only and not in value. $\frac{2}{20}$ of one dollar, or two "nickels," is equal in value to .1 of one dollar or one "dime," though the forms are different.)

(With pencil)

5. Rewrite the following mixed numbers, expressing the fractional parts in decimal form: $8\frac{4}{10}$, $19\frac{8}{10}$, $141\frac{9}{10}$, $27\frac{2}{10}$, $31\frac{8}{10}$.

6. Express the following numbers in arabic numerals, using the decimal point. One hundred eighty and four tenths; ninety-one and forty-two hundredths; one thousand four hundred eighty and twenty-one hundredths.[1]

7. Express the following values in terms of *common* and *decimal* fractions: 1 cent; 10 cents; 50 cents; 25 cents.

8. Express the following values in terms of cents: $\frac{1}{100}$ of a dollar; $\frac{50}{100}$ of a dollar; $\frac{25}{100}$ of a dollar; $\frac{80}{100}$ of a dollar; .01 of a dollar; .50 of a dollar; .25 of a dollar; .80 of a dollar.

9. Rewrite the last four numbers expressed in problem 8 and substitute the term % (per cent) for hundredths. % is another expression for hundredths, or by the hundred. The number .248 when thought of in terms of per cent may be expressed as 24.8 %. In like manner .24 may be expressed as 24 %.

10. Give the fractional, decimal, and per cent equivalents of eight hundredths of one dollar.

11. Express the following per cents in both common and decimal fractions: 1%, 8%, 50%, 80%, 9%, 18%, 41.5%.

12. If 10 eggs out of 100 eggs purchased from a grocer are spoiled, what portion is spoiled? What per cent of the eggs is bad?

[1] For the sake of clearness in the reading of numbers, "and" should be read between a whole number and a fraction only. Read the numbers that you have written and observe this suggestion.

13. If the selling price of straw hats is reduced $\frac{1}{10}$ after July 1st, how much will a Panama hat priced $10 in June cost in July?

14. What is the per cent of reduction on the selling price of straw hats after July 1st? (Problem 13.)

15. If the price of a dress marked $25, is reduced 10% from the selling price, how much does the purchaser save by the reduction.[1]

Optional Problems

16. The Daisy Green Bone Cutter, sold by the Wilson Brothers of Easton, Pa., is catalogued at $18. The firm writes: "To introduce these machines in your neighborhood, we will allow you a discount of 10% from our catalogue price for cash." The reduction is what part of the catalogue price? What per cent of the catalogue price does the company expect to receive? What amount does the company propose to cut the catalogue price? What will the machine cost the purchaser?

17. The Hercules Manufacturing Company of Centerville, Iowa, writes that they will sell their stump pullers at half-price to introduce them into a new territory. Their No. 2 Hercules Stump Puller is catalogued at $200. What will it cost to purchase the first No. 2 Hercules Stump Puller sold in a new territory? What part of the catalogue price does the machine cost? What per cent discount is offered by this company on introductory machines?

18. If a machine catalogued at $200 is sold at 50% of the catalogue price, what does the machine cost?

($200, 50%, and $100 are terms in this transaction.) Which of these terms are stated in the problem and which are to be determined? For convenience these terms are usually called "base," "rate," and "percentage," respectively. ($200 is the base, 50% is the rate, and $100 is the percentage.)

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[1] It is suggested that the data given in local advertisements be used for making problems. The "Removal" sales and "Marked Down" sales supply an abundance of splendid problems in percentage.

34. Use of the Equation

The preceding problem is ordinarily solved as follows:

$$\begin{array}{r} \$200 \\ .50 \\ \hline \$100.00 \end{array}$$

Since \$200 multiplied by .50 gives \$100 as a result we can express it as follows:

$$\$200 \times .50 = \$100$$

The above form of expression is called an *equation*. These marks (=) are known as the sign of equality. The parts of the expression on either side of the sign of equality are known as the members of the equation. Only equal values can be expressed in the form of an equation, hence the members of an equation are always equal in value.

Since the terms in the members of the above equation are known as the base, rate, and percentage, respectively, the equation may be expressed:

$$B \times R = P$$

The base and rate are given and the percentage is to be found.

1. Determine the base, rate, and percentage in problems 15, 16, 17, and 18.

2. Express the base, rate, and percentage given in these problems in the form of an equation. Use numbers when they are given.

In percentage problems often the base and percentage are given to find the rate. Again the rate and the percentage are given to find the base. When a problem in percentage gives two terms, the third can be determined. Problem 18 above can be changed so as to provide the following equations.

$$(1)\quad \$200 \times R = \$100$$
$$(2)\quad B \times .50 = \$100$$

Equation (1) may be solved as follows:

$$\$200 \times R = \$100$$
$$R = \frac{\$100}{\$200} \quad \text{(By dividing both members by \$200)}$$
$$R = .50 \quad \text{(Explain)}$$

Equation (2) may be solved as follows:

$$B \times .50 = \$100$$
$$B = \frac{\$100}{.50} \quad \text{(By dividing both members by .50)}$$
$$B = \$200 \quad \text{(Explain)}$$

3. Explain the processes involved in changing equation (1) to equation (2), etc., in the following exercises: [1]

$$(1)\ B \times R = P$$

$$(2)\ B = \frac{P}{R}$$

$$(3)\ R = \frac{P}{B}$$

(With pencil)

4. What is the income from $200 loaned at 6% for one year? (Express in an equation before solving.)

5. $200 loaned for one year brought an income of $12. What was the rate of interest?
(Express in an equation before solving.)

6. An amount of money loaned for one year at 6% brought $12 interest. What was the amount loaned?
(Express in an equation before solving.)

CASES IN PERCENTAGE

35. Case 1

1. How much butter-fat is there in 40 lb. of milk testing 4% butter-fat? What portion of the weight of the milk is butter-fat?
(Which terms are given? Which one is to be determined?)

2. The average daily milk production of three cows for a period of 200 days was 40 lb., 36 lb., and 30 lb., respectively. If this milk tested 3%, 4%, and 5% butter-fat, respectively, what was the daily yield of butter-fat of each of these cows?

3. Cow No. 33 on the Funk and Wright Farm, near McLean,

[1] The members of an equation are and must be always of the same value either expressed or represented. This principle makes it necessary to modify the values of the members of the equation equally at every complete step in the solution. The first steps in solution consist in getting all of the expressed terms in one member of the equation and the represented terms in the other.

Illinois, produced 6424 lb. of milk for the year 1912–13, testing 4.5% butter-fat. Determine the amount of butter-fat produced by this cow.

4. The Illinois Experiment Station purchased 34 head of choice steers from the Union Stock Yards in Chicago. The aggregate weight of these steers was 36,490 lb. They were purchased for 4.25¢ per pound. The commission charged was approximately 1.2% on the purchasing price of the steers. What was the commission paid the commission merchant?

5. The weight of the fattened steers referred to in problem 4 aggregated 44,650 lb. These steers were sold on the Chicago market for 5.6¢ per lb. If the same rate of commission was charged for selling that was charged for purchasing, what was the commission paid the agent for selling the steers?

6. If these steers dressed 60% of their aggregate gross weight, how many pounds of dressed beef did the entire herd yield?

7. A real estate agent sold 420 A. of land for $85 per acre. He was allowed 2% commission on the selling price for making the sale. What was the agent's commission?

8. Six steers fed at the sub-station at North Platte, Nebraska, weighed 1215 lb., 1092 lb., 1175 lb., 1232 lb., 1251 lb., and 1165 lb., respectively, before leaving the yards. The average shrinkage in weight resulting from transportation to Omaha was 3.1%. What was the aggregate loss in weight of these steers?

9. In a certain sirloin steak the bone was 15% of the weight of the entire cut. If the cut weighed 4 lb., what portion was bone? If the cut cost 30¢ per lb., what did the meat cost per pound?

36. Case 2

1. A boy received 10 qt. of berries out of every 100 qt. of berries that he picked. What portion of the berries picked by him did the boy receive?

2. What per cent of all of the berries picked did the boy get for the picking?

Explanation — He received $\frac{10}{100}$ of all the berries picked. Since per cent means hundredths, $\frac{10}{100}$ may be expressed in terms of per cent as 10%. The boy received 10% of his pickings.

3. What per cent of a number is each of the following fractional parts of it: $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{10}$, $\frac{1}{6}$, $\frac{1}{8}$, $\frac{1}{20}$, $\frac{1}{40}$?

$$\tfrac{1}{4} \text{ of a number} = \frac{25}{100}, \text{ or } .25, \text{ or } 25\% \text{ of it.}$$

4. Six out of a total of 2 doz. eggs purchased were broken. What portion of the eggs purchased was broken?

5. In a recent year a certain farm in Ohio yielded an average of 50 bu. of corn per acre. Because of the continued drouth in the following year the same land yielded but 20 bu. per acre. What per cent of the yield in the former year was the yield in the latter?

6. A steer weighing 800 lb. was fed for 190 days and then sold. Its weight when sold was 1200 lb. Determine the per cent of gain.

(How many pounds did the steer gain? What portion of the first weight was the gain?)

7. A real estate agent charged $5 per acre for selling a tract of land for $50 per acre. What rate did he charge for selling the land?

8. The "1–2–4" concrete mixture is composed of one part of cement, two parts of sand, and four parts of stone or gravel. What per cent of this mixture is composed of cement?

9. At the Kansas Experiment Station three trees of Missouri Pippins yielded 16 bu. of merchantable fruit and 8 bu. of culls, without being sprayed. In another orchard the Missouri Pippins yielded 29 bu. of merchantable fruit and 5 bu. of culls, after a treatment of lime sulphur. How much fruit did the trees produce in each case? What per cent of the fruit grown in each case was culls?

10. A farmer purchased two tracts of land. The first tract of 200 A. cost $200 per acre and yielded a net income of $10 per acre. The

second tract of 120 A. cost $84 per acre and netted an annual income of $6 per acre. What was the per cent of income on each investment?

11. A lot of hogs at the Nebraska Experiment Station averaged 140 lb. at the beginning of the feeding period and 225 lb. at the close of the feeding period. What was the per cent of gain?

12. If the weight of ear corn is 70 lb. per bushel and that of shelled corn 56 lb. per bushel, what per cent of a bushel of ear corn is cob?

Optional Problems

13. When the freight rate for corn is 3¢ per hundred lb., how much more per bushel can the dealer afford to give for shelled corn than for ear corn, provided he gets the same price for each at a distant market?

14. Four acres of land out of a quarter section are used for road purposes. What per cent of this quarter section is used for a road?

15. The normal rainfall in a certain county in Kansas is 24 in. per year. In 1913 the rainfall in this district was 15 in. What per cent of the normal rainfall did this district have in 1913?

16. An Illinois farmer of Champaign County shipped a carload of hogs consisting of 81 head over the Illinois Central Railroad to the Union Stock Yards in Chicago. The aggregate weight in the yards at Chicago was 18,720 lb. The aggregate weight before shipping was 18,970 lb. What was the per cent of shrinkage in making the trip?

17. The commission firm charged $6 for selling the hogs, and the Stock Yards Company charged $6 for the privilege of using the yards. What per cent of the selling price was the cost of disposing of the hogs? The hogs brought $.0825 per pound in Chicago.

18. The freight on this consignment of hogs was $18.50. What per cent of the selling price was the freight?

19. What did the hogs bring in Chicago after expenses were paid? How much was this per pound on the weight in Champaign County?

20. What is the approximate cost per hundred to market hogs from this county?

37. Case 3

1. John bought $\frac{1}{4}$ of George's marbles, and received 6 marbles. How many marbles did George have?

$\frac{1}{4}$ of George's marbles = 6 marbles.
$\frac{4}{4}$ of George's marbles = 24 marbles.

2. Richard bought 25% of James' marbles and obtained 6 marbles from him. How many marbles did James have?

$25\% = \frac{1}{4}$
$\frac{1}{4}$ of James' marbles = 6 marbles.
$\frac{4}{4}$ of James' marbles = 24 marbles.
.25 of James' marbles = 6 marbles.
.01 of James' marbles = $\frac{6}{25}$ marbles.
$\frac{100}{100}$ of James' marbles = $100 \times \frac{6}{25}$ marbles = 24 marbles.

(With pencil)

3. A real estate dealer charged 5% for selling land. He received $600 for selling 150 A. How much was paid for the land? What did the land bring per acre?

4. A man loaned money on several farm properties at 5%. His annual income on these loans was $1240. How much did he loan?

5. An administrator received the legal rate (5%) for settling an estate. His portion amounted to $840. What was the value of the estate?

6. A piece of farm land cash rents for $8 per acre. The taxes and incidental expenses on this land amount to $1.50 per acre. How much does this land net per acre? If money is worth 6%, what is the real value of this land per acre?

(Rate and percentage given to find the base.)

7. A city property rents for \$20 per month. What is the actual value of this property if the taxes, insurance, and incidental expenses amount to \$85 per year?

(Consider money worth 5%.)

8. A grocer's net income is \$3000 per year after deductions for rent and labor are made. What was his per cent of income on a \$12,000 investment?

9. In northern Ohio, a farm rents for \$9 per acre. The increase in land values is sufficient to offset depreciation in buildings and soil fertility. What is the land worth if money can be had at 5% and the taxes are \$.75 per acre?

10. An investor bought two farms of 160 A. each. He purchased one for \$50 per acre, and the other for \$250 per acre. He receives \$4 per acre for the rent of the cheaper land and \$9 per acre for the rent of the more expensive land. Which is the better investment if the land does not increase in value?

11. A farmer raised 3400 bu. of apples in a recent year, which was 50% of what he raised the year before. What was the yield the first year?

12. Daisy Grace De Kol, a Holstein cow, produced 1132.7 lb. of butter in one year. 85% of this butter was butter-fat. Determine the amount of butter-fat produced.

13. The per cent of butter-fat produced by Daisy Grace De Kol the same year was 3.47. How many pounds of milk did she produce?

(See problem 12.)

38. Review of Decimals

(Without pencil)

1. What is the annual income from a loan of \$4000 if the interest rate is 6%.

2. A woman bought 30 yd. of wash goods marked 18¢ per yard at 20% discount from the marked price. What did it cost per yard?

(With pencil)

3. A farmer borrowed $4500 at 6% interest, and gave a mortgage to secure the loan. In addition he paid a loan agent $50 to make the deal, a lawyer $5 for passing upon the abstract, and the county clerk $1 for recording the mortgage. If the money was borrowed for five years, what was the actual rate of interest?

4. A local dealer buys a certain quality of scrim for 11¢ per yard in 30 yd. bolts and retails it at 25¢ per yard. What per cent profit does he make?

5. What would be the per cent of profit on the scrim if sold at 18¢ per yard?

6. Scrim marked 25¢ is sold at 20¢ per yard. What was the per cent of reduction?

7. A drygoods merchant cleared $20 on 80 yd. of table linen which he purchased for 75¢ per yard. How much did he receive per yard for the linen?

8. A brussels rug 9 ft. by 12 ft., previously marked at $35, was sold for $29. For what per cent of the marked price was the rug sold?

9. "Mason" fruit jars may be had of retail dealers for 65¢ per dozen and the "sure seal" jars are retailed at 90¢ per dozen. What per cent of the latter price is the former price?

10. A flock of 23 hens laid 411 eggs in 25 days. The feed cost $4 and the eggs sold for 20¢ per dozen. What was the per cent of profit?

Optional Problems

11. What per cent was the average daily egg production of the number of hens kept?

12. A grocer cleared $5 on 25 gallon jars of maple syrup which he purchased at $1 per gallon. For what did he sell the syrup per gallon?

13. Sugar which had sold previously for \$1.35 per 25 pounds was sold for \$1.65 per 25 pounds at the opening of the canning season. What was the per cent of increase in price?

14. A farmer purchased the following at a sale:

3 cows	for \$180
1 corn drill	" 8
1 wagon	" 22
1 gasoline engine	" 42
80 bu. of corn	" 48

The terms of the sale were a discount of 8% for cash. What was the cash value of his purchase?

15. A creamery in Indiana declared a dividend of 8% on its stock. What was a stockholder's income from 11 \$100 shares of this stock?

16. How many shares did a stockholder have who received a dividend of \$128?

17. An elevator company capitalized at \$8000 paid dividends the first year of \$6500. What was the income from a \$100 share?

39. Simple Interest

Persons who own or control money which they do not care to invest ordinarily loan it to others who need it. It is customary for a borrower to pay for the use of the money which is loaned to him. The amount which the borrower pays is called a premium, a bonus, or more commonly, *interest.*

The amount of interest which is paid is determined both by law and custom. The customary amount of interest is determined by the relation between the supply and demand of money. If the supply is greater than the demand at the customary rate, a lower customary rate is soon established. On the contrary, if the supply of money is quickly taken at the customary rate, a higher rate is soon established. The flow of money into America from Europe during the first two years of the world war, to pay for American products,

materially increased our money supply and consequently lowered the customary interest charge.

The ratio, expressed in per cent, of the amount paid for the use of money (for one year unless provided otherwise) to the amount of money borrowed, is the *rate* of interest charged. When the interest on one hundred dollars is five dollars per year the ratio of

$$\$5 \text{ to } \$100 \text{ is } \tfrac{5}{100}; \text{ or } 5\%$$

Since the rate of interest charged is a per cent, it follows that interest is determined by applying the principles of percentage. See pages 43–47 and 49–50.

By agreement, interest is frequently paid semi-annually and sometimes it is paid quarterly. Banks prefer short loans of three or four months. Some banks collect interest in advance upon short loans. This is generally considered bad ethics and consequently most banks have discontinued the practice.

(With pencil)

1. A farmer purchased 4 shares of creamery stock at $100 per share. The company declared an 8% dividend for five successive years. What was the income upon his investment for the five-year period?

2. A young man borrowed $500 at 6% interest from his father, with which to complete his education. He paid it back as follows: $100 at the end of the second year, $300 at the end of the third year, and $100 at the end of the fourth year. Find the amount of interest he paid annually to his father during these four years.

3. A farmer made the following purchases at a sale: 1 team of horses at $300; 1 wagon at $55; 70 bu. of corn at 65¢ per bushel; 7 tons of alfalfa hay at $19 per ton. He gave his note bearing interest at 6% for one year for the amount purchased. What was the face value of the note at maturity?

(Face value at maturity = amount of note and interest.)

4. A certain trust company pays 4% interest computed quarterly on time deposits. What is the annual income on the original $640 if no withdrawals are made?

5. What is the annual income on $640, at 4% interest, computed annually?

6. A farmer secured a loan of $5000, bearing 5% interest, through a loan agent. The agent charged $1\frac{1}{2}$% for securing the loan. What was the amount of the agent's commission?

7. The above loan was for a period of five years. What was the actual rate of interest after the agent's commission was included in the charge of the loan?

8. A grocer bought an automobile for $1092. He paid $600 cash and gave three equal notes bearing 6% interest for the balance, due in one, two, and three years, respectively. What did the automobile actually cost him?

9. An Ohio farmer was offered 56¢ per bushel for his crop of 9000 bu. of corn. He kept it in the crib for nine months and sold it for 73¢ per bushel. If money was worth 6% interest, how much did he make by holding the corn?

10. A binder was purchased for $150. The purchaser gave two equal notes bearing 6% interest, due in one and two years, respectively, to secure the company. How much was ultimately paid for the machine?

Optional Problems

11. A farmer gave his note for $200 to a bank for 90 days. If the bank charged him 6% and took out 4¢ for revenue stamps, how much did he receive?

12. If one desired to borrow $850 from a bank for 60 days, for what amount shall he give his note if he gets the money at 6% interest?

13. A building and loan company declared an annual dividend of 8% for four successive years. What was Mr. Angel's income from 18 $100 shares?

CHAPTER V. FARM CROPS

40. Cost of Yield per Acre

In a recent year the Nebraska Experiment Station carried on a series of inquiries to determine the average cost of producing one bushel each of corn, oats, and wheat, and one ton each of wild hay, clover hay, and alfalfa hay. The data gathered are shown in the following tables (Nebraska Bulletin, 122, by Pugsley):

TABLE 14

YIELD PER ACRE AND COST, INCLUDING INTEREST AND TAXES ON LAND

	Yield per acre		Cost per acre
Corn	39.3	bu.	$11.627
Wheat	22.2	"	12.188
Oats	35.0	"	11.385
Wild hay	1.25	tons	6.722
Clover	2.04	"	8.538
Alfalfa	3.33	"	10.330

TABLE 15

YIELD PER ACRE AND COST, NOT INCLUDING TAXES AND INTEREST

	Yield per acre		Cost per acre
Corn	39.3	bu.	$6.689
Wheat	22.2	"	7.408
Oats	35.0	"	6.457
Wild hay	1.25	tons	2.722
Clover	2.04	"	3.256
Alfalfa	3.33	"	5.134

1. What was the average total cost of a bushel of corn? A bushel of wheat? A bushel of oats?

2. What was the average total cost of producing a ton each of clover hay and alfalfa hay?

3. What was the average cost of producing a bushel of corn when the taxes and interest were not included?

4. What did the taxes and interest average per bushel of corn? Per ton of clover hay?

5. In figuring the cost of producing wheat and oats, 7.3% depreciation per year was estimated on the value of the machinery used. What amount was allowed for depreciation on a grain drill which cost $65?

6. After the grain drill was used for five years, what was it worth at this rate of depreciation?

(The depreciation is always based on the initial cost.)

7. A farmer has a quarter section of land valued at $110 per acre. The rate of interest is 5%, and the taxes 50¢ per acre. What will it cost him to produce a bushel of oats, if the average yield and cost of production are the same as shown in Table 15?

8. An Iowa farmer owned 160 A. of land worth $180 per acre. He raised 5000 bu. of corn, 800 bu. of wheat, and 20 tons of clover in one year. What was his net profit for that year if corn was worth 70¢ per bushel, wheat $1.20 per bushel, and clover hay sold for $16 per ton, provided the cost of production was the same as that reported in Table 14? There were 100 A. of corn, 40 A. of wheat, and 10 A. of hay.

9. If the farmer referred to in problem 9 had rented the land on a share basis of one half the crop, what would have been his income provided the estimation be based on Table 15?

41. Broadcasting vs. Drilling

At the Nebraska Station, Snyder & Burr gathered data for four years on the drilling and broadcasting of small grains. The results are tabulated as follows (Nebraska Experiment Station Bulletin, 135):

TABLE 16

RESULTS OF THE NEBRASKA EXPERIMENT

Crop	Year	Broadcast (bu.)	Drilled (bu.)
Spring wheat	1908	20.0	29.6
	1909	17.0	27.2
	1910	Failure	2.4
	1912	5.0	5.9
Barley	1908	17.7	27.7
	1909	8.8	17.7
	1910	3.3	7.4
	1912	6.9	13.3
Oats	1908	50.6	52.5
	1909	40.0	67.2
	1910	16.3	18.2
	1912	18.6	21.6
Emmer	1908	46.2	52.6
	1909	22.0	40.6
	1910	17.2	24.6
	1912	18.9	22.2
Winter wheat	1911	12.1	13.9
	1912	17.1	14.6

The figures in the table are estimates based upon the average yields of two plots each year for each of the grains.

1. What was the average yield of each crop for the four years when broadcasting was practiced?

2. What was the average yield of each crop for the four years when drilling was practiced?

3. How much did the average yield per acre of the drilled oats exceed the average yield per acre of the broadcast oats?

4. On the basis of the results in problem 3 what would have been the gain in bushels from drilling 40 A. of oats instead of broadcasting them?

RESULTS OF THE ILLINOIS EXPERIMENT

The Illinois Experiment Station on the Urbana Field carried on a series of tests for three years to determine the relative value of drilling versus broadcasting oats. (Illinois Experiment Station Bulletin 136.)

On 18 plots the first year the drilled oats averaged 61.3 bu. per acre, and the broadcast oats averaged 49.3 bu. The second year the drilled oats averaged 34.1 bu., and the broadcast oats averaged 32.9 bu. The third year on 32 plots the drilled oats averaged 32.9 bu., and the broadcast oats averaged 27.3 bu.

5. Find how much the average yield of the drilled oats exceeded the average yield of the broadcast oats for each of the three years.

6. How much did the average yield of the drilled oats exceed the average yield of the broadcast oats for the three years?

7. A farmer broadcast 40 acres of oats for the three-year period mentioned in the experiment. How many more bushels would he have harvested had he drilled the oats?

(Use data gathered in problem 6.)

8. He marketed the oats at 36¢ per bushel. Estimate the probable increase in his income if he had drilled the oats.

9. At the De Kalb County Field of the Illinois Experiment Station the yield from drilled oats exceeded the yield from broadcast oats each year by 2.7 bu. per acre. On the basis of this yield what was the gain from drilling over that of broadcasting the oats on a forty-acre field for the three-year period? Estimating oats at 36¢ per bushel, how much money was gained by drilling the oats?

10. On the Sibley Field of the Illinois Experiment Station the average yield per acre from drilled oats exceeded that from broadcast oats by 3.6 bu. What would this gain amount to in bushels on a 40-acre tract for two years if the same gain is maintained?

42. Preparation of Soil for Wheat

L. E. Call, of the Kansas Experiment Station, reports, in Bulletin 185 of that station, the results of an experiment covering a period of three

years for determining the relative value of different methods of preparing ground for wheat culture. The results are tabulated as follows:

TABLE 17

PREPARATION OF LAND CONTINUOUSLY IN WHEAT

Method of preparation	Average results for three yrs.		
	Yield per acre (bu.)	Cost per acre for preparation	Value of crop less cost of production
Disked, not plowed	6.63	$2.07	$3.64
Plowed Sept. 15, 3 in. deep	13.24	2.83	8.35
Plowed Sept. 15, 7 in. deep	14.15	3.33	8.60
Plowed Aug. 15, 7 in. deep	22.19	4.00	16.34
Plowed Aug. 15, 7 in. deep and not worked until Sept. 15	20.48	3.33	13.65
Plowed July 15, 3 in. deep	20.77	4.85	12.25
Plowed July 15, 7 in. deep	27.11	5.35	16.87
Double disked July 15 and plowed Sept. 15	19.71	3.93	12.37
Double disked July 15, and plowed Aug. 15, 7 in. deep	23.40	4.93	14.30
Listed July 15, 5 in. deep, ridges split Aug. 15	22.09	3.92	14.73
Listed July 15, 5 in. deep and worked down	22.77	4.05	14.53

PREPARATION OF LAND AFTER ROTATION OF CORN AND OATS

Method of preparation	Average results for one year		
	Yield per acre (bu.)	Cost per acre for preparation	Value of crop less cost of production
Plowed July 15, 3 in. deep	44.08	$4.35	$30.91
Plowed July 15, 7 in. deep	44.66	4.85	30.88
Plowed July 15, 12 in. deep	44.00	8.10	27.10
Plowed Aug. 15, 7 in. deep	41.16	3.55	29.37
Plowed Sept. 15, 3 in. deep	25.50	2.40	18.00

1. Compare the cost of plowing wheat-stubble land 7 in. deep, on July 15, with the cost of plowing oats-stubble land 7 in. deep at the same time?

2. Compare the yields which resulted from the above plowings.

3. Compare the average yield from all of the 3-in. plowings with the average yield from all of the 7-in. plowings.

4. Compare the average cost of all of the 3-in. plowings with the average cost of all of the 7-in. plowings.

5. What was the average cost per bushel of plowing the land 3 in. deep?

6. What was the average cost per bushel of plowing the land 7 in. deep?

7. Compare the average net income from an acre plowed 3 in. deep with the average net income from an acre plowed 7 in. deep.

43. Cost of Growing Corn

C. W. Pugsley, of the Kansas State Experiment Station, set about to determine the cost of producing an acre of grain. Letters were sent to farmers of the State and their estimates were tabulated. Table 18 shows the cost of producing an acre of corn, as determined by this experiment. (Bulletin 122 of the Kansas Station.)

TABLE 18

AVERAGE COST OF PRODUCING AN ACRE OF CORN

Year	1st yr.	2d yr.
Number of replies	186	158
Interest and taxes (or rent)	$4.604	$5.203
Plowing	1.227	1.276
Harrowing	.343	.305
Disking	.407	.481
Seed	.282	.283

Planting	$ .394	$ .408
Cultivating	1.503	1.415
Harvesting	1.431	1.688
Interest and depreciation on machinery	.305	.380
Miscellaneous	.627	.578
Average yield per acre	40.2 bu.	38.4 bu.

1. Find the total cost of producing an acre of corn for the first year. For the second year.

2. Determine the average cost of producing an acre of corn for the two years.

3. Determine the average cost of producing each bushel of corn for the two-year period.

4. Find the total annual cost of producing the corn on a section of land on the basis of the average cost reported in Table 18.

5. If corn was worth 47¢ per bushel, what was the annual net income from the same section of land if the cost and yield per acre were the same as that reported in Table 18 for the first year?

6. If corn was worth 48¢ per bushel, what was the net income from the same section of land for another year, if the annual cost and yield per acre were the same as that reported in Table 18 for the second year?

Optional Problems

7. Estimate the yearly net income from the same section on the basis of an average yield of 50 bu. per acre and a market price of 45¢ per bushel. Cost of production should be estimated on average cost reported in Table 18.

(An allowance should be made for the added cost of harvesting.)[1]

8. Determine the price per bushel required for the corn the first year, to secure a net profit of 10% on the money expended.

[1] In figuring the cost of harvesting, the yield should be multiplied by the cost of harvesting one bushel.

9. In like manner determine the price per bushel required the second year, to secure a net profit of 10% on the money expended.

10. If the average yield for these two years had been 60 bu. per acre, determine the required price per bushel to yield a profit of 10% on the money expended.
(Allow for the added cost of harvesting.)

44. Cost of Growing Wheat

(From Kansas Bulletin 122)

TABLE 19

AVERAGE COST OF PRODUCING AN ACRE OF WHEAT

Year	1st yr.	2d yr.
Number of replies	139	130
Interest and taxes (or rent)	$4.463	$5.098
Plowing	1.273	1.272
Harrowing	.286	.279
Disking	.443	.404
Seed	1.401	1.342
Seeding	.453	.388
Harvesting	2.456	2.110
Interest and depreciation on machinery	.505	.685
Miscellaneous	.727	.734
Average yield per acre	22.9 bu.	21.6 bu.

1. What was the average cost of growing an acre of wheat the first year? The second year? What was the average cost per acre for the 2-year period?

2. For what should the wheat have sold the first year to produce a profit of $10 per acre?

45. Cost of Growing Oats

(From Kansas Bulletin 122)

TABLE 20

AVERAGE COST OF PRODUCING AN ACRE OF OATS

Year	1st yr.	2d yr.
Number of replies	120	149
Interest and taxes (or rent)	$4.693	$5.164
Plowing	1.175	1.004
Harrowing	.272	.299
Disking	.503	.612
Seed	1.349	.908
Seeding	.448	.350
Harvesting	1.949	1.932
Interest and depreciation on machinery	.490	.603
Miscellaneous	.451	.379
Average yield per acre	34.6 bu.	35.5 bu.

1. Determine the average cost of producing a bushel of oats for each of the years.

2. For what price per bushel should oats have sold the first year to make a profit of $8 per acre?

3. If oats were worth 40¢ per bushel the second year, what was the net result per acre on the investment?
(Allow for added cost of harvesting.)

Optional Problems

4. How much should wheat have sold for the first year to yield a net profit of 10% on the money expended?
(See Table 19.)

5. In like manner determine the average price required per bushel of wheat for the two years to net a profit of 6% on the money invested.

6. On the basis of an average of the data in Tables 18, 19, and 20, determine the total expenditures on a section of land for a three-year period when a rotation of corn, oats, and wheat is carried on.

7. If corn is worth 45¢, oats 30¢, and wheat 90¢ per bushel, what is the total net income on the section as conditioned in problem 8?

46. Cost of Growing Hay

(From Kansas Bulletin 122)

TABLE 21

AVERAGE COST OF PRODUCING AN ACRE OF HAY

Number or replies.. 104

	Wild hay	Clover	Alfalfa
Interest and taxes (or rent).......	$3.925	$5.282	$6.196
Labor of cutting and stacking....	2.586	3.010	4.878
Interest and depreciation.........	.211	.246	.256
Average yield (tons).............	1.25	2.94	3.33

1. Determine the average cost per acre of producing clover; alfalfa; wild hay.

2. Determine the average cost per acre of producing each of these hays, if taxes and interest are not included.

3. What per cent of the whole cost of production of each hay are the taxes and interest?

4. What was the average cost per ton of producing each of the hays reported in Table 21.

5. On the basis of the data in Table 21, how much more profitable are 10 acres of alfalfa than 10 acres of clover, if each hay is worth $16 per ton?

47. Results of Growing Cowpeas and Soy Beans

TABLE 22

Tests were carried on for four years at the Kansas Experiment Station to determine the yield per acre of the various varieties of cowpeas and soy beans.

RESULTS OF A FOUR-YEAR TEST

Name of variety	Days to mature	1st year		2d year		3d year		4th year	
		Seed	Hay	Seed	Hay	Seed	Hay	Seed	Hay
Cowpeas									
Mount Olive	114	7.24	1.62	14.96	6.35	11.60	2.05	15.0	1.65
Whippoorwill	111	6.23	1.28	14.25	6.25	16.52	2.79	12.77	1.76
Gray Goose or Taylor	113	2.74	2.12	23.31	3.32	15.87	2.78	15.62	2.54
Hammond's Black	114	6.10	1.84	17.73	2.78	16.03	2.05	8.32	2.49
Black Eye	111	8.00	1.66	19.73	3.28	16.33	2.05	12.37	2.68
New Era	107	11.07	.86	18.86	3.75	12.03	2.57	15.62	2.14
Michigan Favourite	107	7.62	1.16	17.94	2.80	12.40	3.14	14.40	1.85
Warren's New Hybrid	107	6.56	1.78	21.11	3.45	12.76	2.13	18.85	1.50
Old Man's	108	9.10	1.82	20.97	2.90	12.91	2.17	9.12	1.86
White Giant	108	8.62	1.22	17.57	4.88	16.42	1.45	9.33	1.06
Clay	108	1.09	1.97	16.04	3.17	13.85		15.20	1.53
Warren's Extra Early	107	4.21	1.40	17.72	3.15	10.06	1.97	18.45	2.37
Ito San	102	14.80		16.53	1.77	10.13	1.58		1.85
Soy beans									
Small Yellow	109	15.80		16.89	1.95	16.38	1.09		2.29
Green Samarow	105	14.50		13.59	1.94	11.57	1.09		1.75
Early Yellow	99	14.80		20.10	1.96	10.18	1.69		3.01

1. Find the average yield of seed for each of the varieties of cowpeas tabulated above for the 4-year period.

2. In like manner find the average tonnage of each kind of hay for the 4 years.

3. Estimating cowpea hay at $15 per ton, and seed at $3 per bushel, what was the value of the crop of Mount Olive the first year?

4. Determine the average yield of both the hay and seed of the Early Yellow variety of soy beans.

5. In latitudes where both wheat and cowpeas can be raised successfully on the same land in one season, determine the income

from an acre of land producing 20 bu. of wheat per acre and 11 bu. of peas, if the wheat is worth 90¢ per bushel and the cowpeas are worth $3.00 per bushel.

(Straw and hay not considered.)

6. What per cent of the total value of the wheat and peas, referred to in problem 5, is the value of the wheat? The value of the peas?

CHAPTER VI. COMPOSITION AND USE OF FERTILIZERS

48. Nitrogen contained in Crops

TABLE 23

(From Illinois Soil Report No. 2)

1 bu. of corn contains 1 lb. of nitrogen.
1 bu. of oats contains .66 lb. of nitrogen.
1 bu. of wheat contains 1.42 lb. of nitrogen.
1 bu. of oats (grain and straw) contains 1 lb. of nitrogen.
1 bu. of corn (grain and stalks) contains 1.5 lb. of nitrogen.
1 bu. of wheat (grain and straw) contains 2 lb. of nitrogen.
1 ton of timothy hay contains 24 lb. of nitrogen.
1 ton of clover hay contains 40 lb. of nitrogen.
1 ton of cowpea hay contains 43 lb. of nitrogen.
1 bu. of soy beans contains 3.02 lb. of nitrogen.
1 ton of soy beans contains 35 lb. of nitrogen.
1 bu. of soy beans (grain and straw) contains 6.36 lb. of nitrogen.
1 bu. of clover seed contains 1.75 lb. of nitrogen.
1 ton of alfalfa hay contains 50 lb. of nitrogen.
1 bu. of potatoes contains .21 lb. of nitrogen.
½ ton of cotton lint contains 3 lb. of nitrogen.
1 ton of cotton seed contains 63 lb. of nitrogen.
2 tons of cotton stalks contain 102 lb. of nitrogen.
1 ton of sweet clover contains 40 lb. of nitrogen.

NOTE — One fourth of the total nitrogen in clover is in the roots and stubble.

One third of the total nitrogen in alfalfa is contained in the roots and stubble.

One tenth of the total nitrogen in soy beans and cowpeas is contained in the roots and stubble.

1. Determine the amount of nitrogen taken from a 10-acre field which produced an average of 37 bu. of oats per acre.

(Straw returned to the soil.[1])

2. Estimate the loss of nitrogen to the soil of this field for a period of 10 years, if the successive yields of oats per acre were, respectively, 35 bu., 33 bu., 30 bu., 30 bu., 28 bu., 28 bu., 26 bu., 25 bu., 25 bu., and 20 bu.

(Straw returned to the soil.)

3. Estimate the amount of nitrogen needed to produce a yield of 60 bu. of corn per acre.

4. Estimate the amount of nitrogen needed to produce an average of 38 bu. of corn per acre on a 29-acre field.

5. Estimate the nitrogen taken from 1 acre of ground in 2 years where wheat and corn were alternated, if the average yield of wheat was 30 bu. per acre, and that of the corn 50 bu. per acre.

6. Determine the amount of nitrogen that is added to the soil by plowing under 2 tons of clover per acre.[2]

7. In a 3-year rotation of clover, wheat, and corn, in which the clover was plowed under, determine the loss or gain of nitrogen, if the average yields were 2.5 tons of clover, 30 bu. of wheat, and 60 bu. of corn, respectively.

(Wheat, straw and corn stalks were returned to the soil.)

Optional Problems

8. A farmer sows cowpeas in his corn each summer and plows the cow peas under. If the annual yield of corn is 60 bu. per acre

[1] Unless otherwise stated both grain and stalks should be considered in determining the quantity of nutrient taken from the soil by the crop.

[2] In normally productive soils about one third of the nitrogen in the entire clover plant is taken from the soil, and the remaining two thirds is taken from the air by the bacteria living on the roots of the plant. This is true of clover and other legumes, such as soy beans and cow peas. Plants that are not legumes take no nitrogen from the air.

and that of the cowpeas is $1\frac{1}{3}$ tons per acre, what is the gain or loss in nitrogen per year?

9. A 10-acre tract of land was planted in corn for a period of 12 years. Five tons of barnyard manure were spread on each acre at the close of each 3-year period. If the corn yielded an average of 60 bu. per acre, and the stalks were left upon the land, what was the actual shortage in nitrogen at the end of the 12-year period?

(See Table 25, page 73.)

10. Determine the gain or loss in nitrogen per acre in the following 4-year rotation of corn, oats, wheat, and red clover, if the yield per acre is 50 bu. of corn, 40 bu. of oats, 30 bu. of wheat, and 2.5 T. of clover, provided the clover, stalks, and straw are turned under.

11. What was the loss or gain of nitrogen per acre in a 3-year rotation of corn, oats, and clover, if the clover stalks and straw were turned under, provided the average yield was 2.5 T. of clover, 60 bu. of corn, and 35 bu. of oats?

12. What is the result in pounds of nitrogen of a 4-year rotation of clover, corn, oats, and soy beans if the soy-bean straw was returned to the soil and two bushels of beans were harvested per acre, provided the yield of soy-bean straw was 2 T. per acre and the yield and treatment of the other crops was the same as that reported in problem 11?

(See Table 25.)

13. After clearing a tract of land a farmer raised upon it three crops of corn in succession averaging 56 bu. per acre. He then raised in succession three crops of wheat yielding 20 bu., 26 bu., and 35 bu., respectively. If he burnt the corn stalks and sold the wheat straw, how much nitrogen was taken from the soil?

49. Results of Rotating Crops

On the Urbana Field of the Illinois Experiment Station results were obtained in three different rotations. The soil was not treated in any way. (Illinois Soil Report.)

TABLE 24

ROTATION OF CORN, OATS, AND CLOVER

Year	Continuous cropping	2-year rotation		3-year rotation		
	Corn (bu.)	Corn (bu.)	Oats (bu.)	Corn (bu.)	Oats (bu.)	Clover (tons)
1889	43.2	..	37.4	..	..	4.04
1890	48.7	54.3	..	..	..	1.51
1891	28.6	33.2	..	..	..	1.46
1892	33.1	..	37.2	67.6	..	..
1893	21.7	29.6	..	34.1	..	..
1894	34.8	..	57.2	..	65.1	..
1895	42.2	41.6	..	..	22.2	..
1896	62.3	..	34.5	..	..	..
1897	40.1	47.0	..	..	..	..
1898	18.1	..	..	..	..	..

1. When corn was grown continually, what was the average yield for the 10 years?

2. When corn was grown continually, what per cent of the average yield for the first 5 years was the average yield for the last 5 years?

3. How much nitrogen was removed in the grain from an acre of corn land, for the 10-year period?
(See Tables 24 and 25.)

4. Determine the average amount of nitrogen removed from one acre of soil by each crop in the 2-crop rotation.

5. Compare the amount of nitrogen contained in an average clover crop with the amount of nitrogen contained in an average yield of each of the grains grown in the 3-crop rotation.

6. How many tons of clover must be turned under per acre to replace the nitrogen removed in the grain of the 10 crops of corn reported in Table 25?

50. Fertility in Crops and Fertilizers

TABLE 25

(From Hopkins's Soil Fertility and Permanent Agriculture)

PRODUCE

Kind	Amount	Nitrogen (lb.)	Phosphorus (lb.)	Potassium (lb.)
Corn (grain)	1 bu.	1	.17	.19
Corn (grain and stalks)	1 bu.	1.5	.23	.71
Oats (grain)	1 bu.	.66	.11	.16
Oats (grain and straw)	1 bu.	.97	.16	.68
Wheat (grain)	1 bu.	1.42	.24	.26
Wheat (grain and straw)	1 bu.	1.92	.32	1.16
Soy beans (seed)	1 bu.	3.20	.52	.96
Soy beans (seed and straw)	1 bu.	6.36	.84	2.92
Timothy hay	1 ton	24.	3.3	14.0
Clover seed	1 bu.	1.7	.5	.7
Clover hay	1 ton	40.0	5.0	30.0
Cowpea hay	1 ton	43.33	4.66	32.66
Alfalfa hay	1 ton	50.	4.50	24.00
Cotton lint	1 ton	6.0	.8	8.0
Cotton seed	1 ton	63.0	11.0	19.0
Cotton stalks	1 ton	51.0	9.0	28.5
Potatoes	1 bu.	.21	.043	.3
Sugar beets	1 ton	5.00	.9	7.85
Fat cattle	1 ton	50.00	14.0	2.0
Fat hogs	1 ton	36.00	6.00	2.0
Milk	1 ton	11.40	1.40	2.4
Butter	1 ton	4.00	1.00	1.0
Fresh farm manure	1 ton	10.00	2.00	8.0
Barnyard manure	1 ton	10.00	3.00	8.0
Corn stover	1 ton	16.00	2.00	17.00
Dried blood	1 ton	280.00	0.00	0.00
Sodium nitrate	1 ton	310.00	0.00	0.00
Ammonium sulphate	1 ton	400.00	0.00	0.00
Raw bone meal	1 ton	80.00	180.00	0.00
Steamed bone meal	1 ton	20.00	250.00	0.00
Acidulated bone meal	1 ton	40.00	140.00	0.00
Raw rock phosphate	1 ton	0.00	250.00	0.00
Acid phosphate	1 ton	0.00	125.00	0.00
Double super phosphate	1 ton	0.00	400.00	0.00
Basic slag phosphate	1 ton	0.00	160.00	0.00
Potassium chloride	1 ton	0.00	0.00	850.00
Potassium sulphate	1 ton	0.00	0.00	850.00
Kainite (kī nīte)	1 ton	0.00	0.00	200.00
Wood ashes	1 ton	0.00	10.00	100.00
Oat straw	1 ton	12.00	2.00	21.00
Wheat straw	1 ton	10.00	2.00	14.00

1. Determine the amount of phosphorus taken from an acre of land which yielded 40 bu. of corn, the stalks remaining on the land.

2. Estimate the amount of phosphorus taken from an acre of land which yielded 40 bu. of corn, if the stalks were removed from the land.

(See Table 25.)

3. How much phosphorus is taken from an acre of soil which produces 30 bu. of wheat when the straw is returned to the land?

4. How much phosphorus is required to produce 25 bu. of wheat per acre for 5 years when the straw is removed?

5. In order to replace the phosphorus supply removed annually by 50 bu. of corn per acre, how much steamed bone meal should be added to each acre?

(See Tables 23 and 25.)

6. How much raw rock phosphate should be added to each acre every third year to maintain the phosphorus content of the land, where a rotation of corn, oats, and clover is practiced and the average yields are 50 bu. of corn, 2.5 tons of clover, and 46 bu. of oats?

7. How many tons of barnyard manure should be added per acre every third year to keep up the supply of nitrogen in the soil referred to in problem 6, if all the straw and stalks are returned to the land?

8. A farmer has a quarter section of land on which he practices a 3-year rotation of corn, oats, and clover. The stalks, straw, and clover are all plowed under, and the corn, oats, and clover seed are sold. The corn averages 70 bu. per acre, the oats 60 bu., and the clover $1\frac{1}{2}$ tons of hay and 2 bu. of seed per acre. If this farmer applies 700 lb. of raw rock phosphate per acre every 3 years, what will be the gain or loss in both nitrogen and phosphorus per acre at the end of a 15-year period?

9. If he should add 700 lb. of acid phosphate per acre every 3 years, what will be the gain or loss in phosphorus at the close of a 15-year period?

10. Raw rock phosphate is quoted at $7.50 per ton, and acid phosphate at $15 per ton. What will the phosphorus supplied as provided in problems 8 and 9 cost?

11. What does phosphorus cost per pound when purchased in raw rock phosphate?

12. Determine the potassium taken in 10 years from an acre of soil which has produced alternately 35 bu. of wheat and 60 bu. of oats.

13. Determine the amount of potassium taken from an acre of soil which yields 40 bu. of corn, if the stalks remain on the land.

14. Determine the amount of potassium chloride needed per acre for a 3-year period to maintain the potassium content of a soil which produces 50 bu. of corn, 30 bu. of wheat, and 55 bu. of oats each 3-year period, if the stalks are returned to the field.

15. If the straw and stalks referred to in problem 14 are taken from the soil, how much potassium chloride is needed to replace the potassium taken by the crops?

16. What is the value of the potassium contained in a bushel of corn, if purchased in the form of kainite costing $18 per ton?

17. If potassium is purchased in the form of potassium chloride, quoted at $51 per ton, what is the cost of the potassium required to produce a bushel of corn (grain and stalks)? A bushel of wheat (grain and straw)? A bushel of oats (grain and straw)?

51. Use of Limestone and Caustic Lime

The Maryland Experiment Station carried on a series of experiments covering a period of 11 years, to determine the effect of limestone and caustic lime on crop production. (Hopkins's *Soil Fertility and Permanent Agriculture*.)

TABLE 26

EFFECTS OF LIMESTONE AND CAUSTIC LIME ON CROPS

Kinds of lime used	Total amount produced in eleven years		
	Corn (bu.) 4 crops	Wheat (bu.) 3 crops	Hay (tons) 4 crops
None	98	32	2.60
Caustic lime burned from stone	128	32	3.09
Caustic lime burned from shells	129	34	2.82
Calcium carbonate in ground shells	148	42	3.97
Calcium carbonate in shell marl	145	43	4.29

The above yields are estimates, each of which is based on the average of two plots. The yield reported in each case is the total amount produced by the number of crops indicated by the column heading. Thus in the first column 98 bu. is the total amount of corn produced on an acre in four crops.

1. What was the average yield per crop of corn, wheat, and hay on the plots where caustic lime was used?

2. What did the corn, wheat, and hay average per crop on the plots where the calcium carbonate in the form of ground shells was used?

3. How much did the caustic lime increase the average yield of each crop of corn?

4. How much did the calcium carbonate increase the average crop of wheat?

5. What was the average gain per crop of corn, wheat, and hay due to the use of burned limestone?

6. If 2 tons of limestone are required to correct the acidity of an acre of land, how much quick lime is required to do the same amount of work? How much water-slaked lime is required? [1]

[1] 100 lb. of limestone for neutralizing acids is equivalent to 56 lb. of quick lime or 74 lb. of water-slaked lime. (Abott, in Indiana Circular 33.)

7. If limestone is quoted at $1.50 per ton, what are quick lime and water-slaked lime worth on the basis of their neutralizing power?

8. If ground limestone is worth $1 per ton, what are quick lime and water-slaked lime worth per ton?

52. Plant Food removed by Crops

The following data are taken from Bulletin 169 of the Kansas Experiment Station. The work was carried on by Willard, Swanson, and Wiley, and is a summary of the elements taken from the soil by the various crops.

TABLE 27

AMOUNT AND VALUE OF PLANT FOOD REMOVED BY CROPS*

Crop	Gross yield (lb.)	Nitrogen		Phosphorus		Potassium	
		Weight (lb.)	Cost	Weight (lb.)	Cost	Weight (lb.)	Cost
Wheat (20 bu.)	1200	25	$5.00	5.46	$0.44	5.81	$0.35
Straw	2000	10	2.00	3.27	.26	23.24	1.40
Barley (40 bu.)	1920	28	5.60	6.55	.52	6.60	.40
Straw	3000	12	2.40	2.18	.17	24.90	1.50
Oats (50 bu.)	1600	35	7.00	5.24	.42	8.30	.50
Straw	3000	15	3.00	2.62	.21	29.10	1.75
Corn (65 bu.)	3640	40	8.00	7.86	.63	12.45	.75
Stalks	3000	35	7.00	.87	.07	49.80	3.80
Mangels	20000	75	15.00	15.28	1.22	12.45	.75
Meadow hay	2000	30	6.00	8.73	.70	37.40	2.25
Clover	4000	**	..	12.23	.98	54.80	3.30
Alfalfa	8000	..	..	13.75	1.10	200.8	12.09
Potatoes (150 bu.)	9000	40	8.00	8.75	.70	62.30	3.75
Flax (15 bu.)	900	39	7.00	6.55	.52	6.60	.40
Straw	1800	15	3.00	1.31	.11	15.80	.95
Peas (30 bu.)	1800	..	..	7.86	.63	18.30	1.10

* The amount of the elements shown in the table does not conform exactly with the amount shown in Table 23. This is due to the fact that Table 23 represents the average amount of several analyses.

** Legumes return nitrogen to the soil when plowed under. When the hay is taken off there is neither loss nor gain since ⅓ of the nitrogen contained in the entire plant is in the roots. This is the amount the plant takes from the soil. (See note page 70.)

1. With the aid of the above table determine the amount of nitrogen removed from the soil in the production of 100 lb. of wheat.
(Straw not included.)

2. Determine the amount of nitrogen removed from the soil by 100 lb. of wheat straw.[1]

3. Determine the value of the nitrogen required to produce 100 lb. of barley with its accompanying straw.

4. Estimate the amount of nitrogen taken from the soil by 25 bu. of corn.

5. How much nitrogen will be returned to the soil by plowing under the stalks from a 40-bu. crop of corn?

6. Determine the amount of phosphorus taken from an acre of soil by a crop of 35 bu. of corn, provided that the stalks are returned to the soil.

7. Determine the amounts of phosphorus and potassium, respectively, taken from the soil by 1 bu. of wheat, including roughage.

Optional Problems

8. Determine the amount of clover that should be plowed under to supply the nitrogen taken by 3 successive crops of corn averaging 56 bu. per acre, provided the stalks were left on the land.
(See Tables 23 and 25 for clover.)

9. How much nitrogen, phosphorus, and potassium will be removed from an acre of soil in a period of 3 years by a rotation of corn, oats, and wheat, averaging 65 bu., 58 bu., and 28 bu., respectively?

10. How much fresh farm manure, containing the elements listed in Table 25, is required to supply the nitrogen removed by the crops referred to in problem 9?

[1] Unless otherwise stated the problems listed under this table should be based upon the data contained in it.

11. How much phosphorus was added to the soil by the manure provided in problem 10?

12. Similarly, how much kainite is required to supply the potassium not supplied by the manure provided in problem 10?

53. Plant Food contained in Manure

The following table, showing the amounts of plant food in the excrements of the various farm animals, is quoted from Van Slyke, of the New York Experiment Station. The figures represent the amount of plant food produced annually in the solid and liquid excrements per 1000 pounds of live weight.

TABLE 28

Animal	Weight of mixed excrements (lb.)	Weight of bedding (lb.)	Weight of total manure (lb.)	Nitrogen weight (lb.)	Phosphorus weight (lb.)	Potassium weight (lb.)
Horse	18000	6000	24000	158	27	120
Cow	27000	2000	29000	171	21	120
Pig	30500	6000	36500	180	54	140
Sheep	12500	7000	19500	154	29	145
Steer	15000	3000	10000	135	24	60
Hen	8500		8500	85	30	28

Straw containing .5% nitrogen, .13% phosphorus, and .6% potassium was used for bedding.

1. How much nitrogen is contained in the manure produced annually from a stable of 10 horses averaging 1000 lb. each?

2. How much phosphorus is contained in the manure produced annually from the same stable?

3. Similarly, find the amount of potassium contained in the manure referred to in problems 1 and 2.

4. How many pounds of each of the above elements are contained in 1 ton of the manure from a horse stable?

5. How much of this manure is necessary to supply the nitrogen for 3 30-bu. crops of wheat?

(See Table 25.)

6. Determine the per cent of nitrogen, phosphorus, and potassium, respectively, in the manure of each of the following animals: horses, cows, sheep, pigs, and hens.

(The total weight of manure is the base and the amount of each element is the percentage, the rate is to be found.)

Optional Problems

7. Estimating the average weight of cows at 900 lb., how much nitrogen, phosphorus, and potassium will the manure on a dairy farm of 20 cows yield annually?

8. If there are 10 1000-lb. horses on the above farm, what is the yearly yield of nitrogen, phosphorus, and potassium from the manure?

9. Referring to Table 25 for the nutrients taken from the soil by the various crops, determine the amount of horse manure that should be spread over an acre of land every four years to replenish the nitrogen taken by 4 corn crops averaging 50 bu. per acre.

10. In like manner determine the amount of horse manure needed annually to keep the supply of nitrogen normal when the average yield of wheat is 30 bu. per acre.

11. Determine the cost of potassium per pound in potassium chloride purchased at $41 per ton. In like manner determine its cost per pound in each of the following fertilizers used: potassium sulphate at $48 per ton, kainite at $12 per ton, and wood ashes at $12 per ton.

(See Table 25.)

12. Potash is a compound of potassium and oxygen; 100 lb. of potash contains 83 lb. of potassium. What is the per cent of potassium in potash?

13. Determine the cost per pound of potassium in potassium chloride worth $50 per ton.

14. A certain commercial fertilizer is guaranteed to contain 6% potassium chloride. What is the actual per cent of potassium in the mixture.

(See Table 25.)

15. In 100 lb. of phosphoric acid there are 43.7 lb. of phosphorus. If a commercial fertilizer contains 12% phosphoric acid, what is the per cent of phosphorus?

16. What per cent of phosphoric acid should a commercial fertilizer contain to equal the amount of phosphorus in raw rock phosphate containing 13% phosphorus?

54. Cost of Fertilizers

The following tables are quoted from Van Slyke, of the New York Experiment Station. They show the retail cost of nitrogen, phosphorus, and potassium fertilizers.

TABLE 29

Material	Retail price per ton	Per cent of		
		Nitrogen	Phosphorus	Potassium
Sodium nitrate	$46.00	15.65	..	..
Ammonium sulphate	66.00	20.60	..	..
Dried blood	60.00	13.20	..	..
Calcium cyanamid	53.00	18.	..	..
Acid phosphate	13.00	..	6.2	..
Basic-slag phosphate	14.25	..	7.0	..
Ground rock phosphate	8.00	..	12.3	..
Potassium chloride	41.00	..	..	41.5
Potassium sulphate	48.00	..	..	40.0
Potassium carbonate	79.00	..	..	50.0
Kainite	12.00	..	..	10.0
Wood ashes	12.00	..	..	5.0
Steamed bone meal	26.00	1.0	10.08	..
Raw bone meal	30.00	3.0	8.4	..

1. How many pounds of nitrogen are there in a ton of sodium nitrate?

2. What does nitrogen cost per pound when secured in ammonium sulphate?

3. How many pounds of phosphorus are there in a ton of acid phosphate?

4. What does phosphorus cost per pound when secured in basic-slag phosphate?

5. Obtain the cost per pound of phosphorus, when obtained through the purchase of steamed bone meal.

Optional Problems

6. The Rhode Island Experiment Station reports the following results from the use of phosphates: 189 lb. of corn were produced on a plot where no phosphorus was used, and 226 lb. were produced upon a similar plot where steamed bone meal was used. Determine the per cent of increase in corn through the use of bone meal.

7. Determine the cost of the phosphorus in 50 bu. of corn when supplied through the use of ground rock phosphate.

8. A Canadian Experiment Station reports the following results in the use of fertilizers in the growing of potatoes: no fertilizers, 100 bu. per acre; 200 lb. of sodium nitrate, 123 bu. per acre; 150 lb. of potassium chloride, 139 bu. per acre; and 300 lb. of ammonium nitrate, 300 bu. per acre. If potatoes were worth 35¢ per bushel, what was each fertilizer worth on the basis of the one crop?

55. Plant Food produced by Animals

The following table, quoted from Van Slyke, of the New York Experiment Station, represents the amount of nitrogen, phosphorus, and potassium that is produced annually by the various farm animals per *1000 pounds* of live weight:

TABLE 30

Kind of animal	Nitrogen		Phosphorus		Potassium	
	Solid (lb.)	Liquid (lb.)	Solid (lb.)	Liquid (lb.)	Solid (lb.)	Liquid (lb.)
Horse	79	49	19		48	37
Cow	76	80	17		16	90
Pig	101	49	40	5.3	61	46
Sheep	62	57	18.5	.9	32	73
Hen	85		30.		27	

1. How many pounds of nitrogen are produced annually by a horse weighing 1000 lb.? By a horse weighing 900 lb.? 1100 lb.?

2. How much nitrogen is produced by five hogs each weighing 200 lb.?

3. How much phosphorus will a team of horses weighing 2000 lb., and three cows weighing 3000 lb. produce in one year?

4. A farmer has the following live stock on his farm: 10 horses averaging 1175 lb., 60 steers averaging 925 lb., 100 hogs averaging 185 lb., and 300 hens averaging 5 lb. Determine the amount of nitrogen, phosphorus, and potassium produced annually by all of this live stock.

NOTE — Different weights are reduced to a thousand-pound basis by changing the decimal point three places to the left.

Example: The 10 horses referred to above will weigh 1175 lb. × 10 or 11750 lb. This is 11.750 times as much as one horse weighing 1000 lb. The table gives the amount produced by one horse weighing 1000 lb. The 10 horses referred to in problem 4 will produce 11.75 times as much plant food as will a 1000-lb. horse.

5. Determine the amount of nitrogen, phosphorus, and potassium produced annually in liquid manure by a team of horses weighing 2800 lb.

6. The nitrogen in the liquid manure is worth 16¢ per pound for fertilizer, and the nitrogen in the solid manure is worth only about 12¢ per pound, since it becomes available for plants more slowly. What is the value of the nitrogen produced yearly by the team mentioned in problem 5?

7. If the phosphorus produced by the team referred to in problem 5 is worth 3¢ per pound, and the potassium 5¢ per pound, what is the total value of the manure produced yearly by this team?

Optional Problems

8. If horse manure is left in the open air for six months, how much nitrogen is lost per ton?

(See Table 28.)[1]

9. If a ton of manure is thrown into the yard and allowed to weather until 70% of the plant food is lost, how many pounds of nitrogen will have been lost? How many bushels of corn is this amount of nitrogen capable of producing?

10. Find the number of bushels of corn that the phosphorus similarly wasted is capable of producing.

(Use Table 25.)

Animal Census of the United States

Table 31 is quoted from the report of the United States Department of Agriculture. It represents the number of domesticated animals of all kinds shown in the United States by the census of 1910.

TABLE 31

Horses	21,040,000
Mules	4,123,000
Cattle	69,080,000
Sheep	57,216,000
Swine	47,782,000

11. If the horses in the United States average 1000 lb., what is the value of the nitrogen produced by these horses for one year, provided nitrogen is worth 16¢ per pound?

12. Estimate the value of the phosphorus and the potassium produced by these horses if it is quoted at 3¢ per pound and 5¢ per pound, respectively.

[1] Van Slyke, of the New York Experiment Station, estimates that manure allowed to rot in the open air for six months will lose 70% of its plant food.

Optional Problems

13. If the average weight of all the mules in the United States is 800 lb., and the excrement produced by them is the same composition as that of the horses, what is the value of the plant food in the solid and liquid excrements produced by the mules in the United States in 1910?

14. If 70% of the manure referred to in problem 13 is lost by weathering, what is the money value of the plant food lost in this way in the United States in 1910?

15. Determine the number of pounds of phosphorus, nitrogen, and potassium produced by all the farm animals in the United States in 1910 if their weights averaged as follows: horses, 1000 lb.; mules, 800 lb.; cattle, 500 lb.; hogs, 100 lb.; and sheep, 70 lb.

16. Referring to Table 25, determine the number of bushels of corn that the nitrogen produced by the animals reported in Table 31 would produce.

17. 70% of this nitrogen was lost by leaching. Determine this loss in terms of bushels of corn.

18. From prices quoted in problems 11 and 12 above for plant foods, determine the value of the farm manure in the United States for the year 1910. Use data obtained in problem 15.

56. Plant Food in Illinois Soils

The following table is taken from Hopkins's *Soil Fertility and Permanent Agriculture*. It represents the amount of nitrogen, phosphorus, and potassium in $6\frac{2}{3}$ in. of the surface soil in the various types of soils common to Illinois. In each case the amount of plant food is based on 2,000,000 lb. of soil, which is the estimated weight of one acre of surface soil. In the case of the sand soil, 2,250,000 lb. is used as a base. While these soils are common to Illinois, they are also common to all sections of the United States where glaciation has taken place.

TABLE 32

AVERAGE NUMBER OF POUNDS PER ACRE OF PLANT FOOD, IN 6⅔ INCHES OF SURFACE SOIL

Soil area or glaciation	Soil Type	Total nitrogen (lb.)	Total phosphorus (lb.)	Total potassium (lb.)
Prairie lands, undulating				
Lower Illinoisan	Brown silt loam on tight clay	2,800	840	24,490
Middle Illinoisan	Brown silt loam	4,370	1,170	32,240
Upper Illinoisan	Brown silt loam	4,870	1,200	32,940
Pre-Iowan	Brown silt loam	4,290	1,190	35,320
Iowan	Brown silt loam	4,910	1,220	32,960
Early Wisconsin	Brown silt loam	5,050	1,190	36,250
Late Wisconsin	Brown silt loam	6,750	1,410	45,020
Prairie lands, flat				
Lower Illinoisan	Drab silt loam	2,800	710	26,260
Middle Illinoisan	Black clay loam	5,410	1,413	31,860
Upper Illinoisan	Black clay loam	6,760	1,690	29,770
Early Wisconsin	Black clay loam	7,840	2,030	35,140
Late Wisconsin	Black clay loam	8,900	1,870	37,370
Timber uplands, rolling or hilly				
Unglaciated	Yellow silt loam	1,890	950	31,450
Lower Illinoisan	Yellow silt loam	2,150	950	31,850
Middle Illinoisan	Yellow silt loam	1,870	820	33,470
Upper Illinoisan	Yellow silt loam	2,010	840	34,860
Pre-Iowan	Yellow silt loam	2,390	850	37,180
Early Wisconsin	Yellow silt loam	1,890	870	32,720
Deep Loess	Yellow fine sandy loam	2,170	960	35,640
Iowan	Yellow fine sandy loam	1,910	910	35,780
Timber uplands, undulating				
Late Wisconsin	Yellow gray silt loam	2,890	810	47,600
Iowan	Brown sandy loam	3,070	850	26,700
Timber uplands, flat				
Lower Illinoisan	Light gray silt loam on tight clay	1,890	810	2,728
Sand, swamp, and bottom lands				
Old bottom lands	Deep gray silt	3,620	1,420	36,350
Sand plains and dunes	Sand loam	1,440	820	30,880
Late swamp	Deep peat	23,880	1,960	2,930
Late swamp	Drab clay	5,760	1,900	48,080
Late swamp	Marly peat	20,900	1,520	920
Late bottom lands	Brown loam	4,720	1,620	39,970

1. Determine the amount of nitrogen in the Late Wisconsin brown silt loam after 6 crops of corn averaging 50 bu. per acre have been removed.[1]

2. Find the amount of phosphorus in the Late Wisconsin brown silt loam after 8 crops of corn, averaging 50 bu. per acre, have been removed.

3. Compare the phosphorus of the Upper Illinoisan brown silt loam with the Upper Illinoisan black clay loam.

4. Compare the phosphorus of the Lower Illinoisan drab silt loam with the fertility of the Lower Illinoisan yellow silt loam.

Optional Problems

5. Determine the amount of available nitrogen that should be added to the Late Wisconsin yellow gray silt loam to make it capable of producing 60 bu. of corn to the acre.[2]

6. Determine the amount of ground rock phosphate needed to enrich the Late Wisconsin yellow gray silt loam to the point where 13 lb. of phosphorus are available each year.

57. Plant Food consumed in the United States

Table 33 is the census report for 1910 upon the number of acres planted and the number of bushels produced by each of the major farm crops in the United States.

TABLE 33

Crop	Acres	Bushels
Corn	114,002,000	3,125,713,000
Wheat	49,205,000	695,443,000
Oats	35,288,000	1,126,765,000
Rye	2,028,000	33,039,000

[1] Unless otherwise stated, both grain and roughage are considered removed from the soil.

[2] It is assumed that 2% of the nitrogen, 1% of the phosphorus, and ¼% of the potassium are made available for crops each year by good farming methods.

Crop	Acres	Bushels
Barley	7,257,000	162,227,000
Buckwheat	826,000	17,239,000
Flaxseed	2,916,000	14,116,000
Rice	722,000	24,510,000
Potatoes	3,591,000	338,811,000

1. Determine the amount of nitrogen taken from the soil by the grain of the corn crop of 1910.

2. What was the amount of the phosphorus taken from the soil in 1910 by the grain of the wheat crop in the United States. (See Table 25.)

3. Determine the average yield per acre of the corn, wheat, and oats produced in the United States in 1910.

4. Determine the average amount of potassium taken from an acre of soil by the oats crop of 1910.

5. What was the average value per acre of the corn, wheat, and oats grown in the United States in 1910, if corn was worth 50¢ per bushel, wheat 90¢ per bushel, and oats 35¢ per bushel.

58. Use of Fertilizers in growing Hay

The following table is an analysis of the expenditures and receipts resulting from the addition of fertilizers to a 60-acre tract of hay land on a New York farm. The fertilizers added increased the yield of hay 1 ton per acre on the entire field.

TABLE 34

8000 lb. of nitrate of soda	$185.00
2080 lb. of muriate of potash	39.77
10354 lb. of acid phosphate	47.37
Other costs —	
Freight on fertilizer	26.66
29.5 man hours hauling fertilizer @ 21.6¢	8.53
58.0 horse hours hauling fertilizer @ 13.2¢	7.66
29.0 man hours mixing fertilizer	6.26
84.5 man hours sowing fertilizer	18.25

101.5 horse hours sowing fertilizer	$13.40
200 man hours hauling in 60 T. of hay	43.20
160 horse hours hauling in 60 T. of hay	21.12
108 man hours pitching hay to baler	23.33
Meals for hay pressers	14.40
Meals for hay pressers' horses	7.30
118 hours man labor hauling 60 tons to railroad	25.49
208 horse hours hauling 60 T. to railroad	27.56
Use of barn (proportionate share)	95.00
Fire insurance (proportionate share)	3.00
Interest above costs for 7 Mo. at 6%	21.46

1. Find the total cost of the fertilizers.

2. Find the cost of each fertilizer per ton.

3. Find the total cost of getting the fertilizers on the field including the initial cost, the freight, and other labor expenses.

4. What was the total cost per ton of hay for fertilizers and all items of labor and expense connected with marketing the hay?

5. What was the income on the hay at $11 per ton after the expenses provided in Table 34 were deducted?

6. What was the gross income on the hay if it sold for $14 per ton?

59. Miscellaneous Problems

1. A complete fertilizer is one which contains nitrogen, phosphorus, and potassium. It is generally mixed so that these plant foods occur in some definite proportion. The phosphorus and potassium are usually quoted in per cent of phosphoric acid and potash. For example, a fertilizer having a composition of 2:8:6 means a fertilizer which contains 2% nitrogen, 8% phosphoric acid, and 6% potash. Determine the number of pounds of nitrogen, phosphoric acid, and potash in a ton of 2:8:6 fertilizer.[1]

[1] All mixtures are based upon one ton in weight. The compounds when proportioned to provide the required elements do not weigh a ton, consequently sand is added to make up the deficiency.

2. What should this fertilizer sell for per ton, when each element in the fertilizer is quoted as follows: nitrogen, 16¢ per pound; phosphoric acid, 4¢ per pound; and potash 5¢ per pound.

3. Determine the number of pounds of nitrogen, phosphoric acid, and potash in a ton of 4:8:7 fertilizer.

(Read, "a four, eight, seven fertilizer.")

4. Compare the value of one ton of this fertilizer with one ton of that referred to in problem 2.

5. Make a mixture of rock phosphate and kainite to form a fertilizer containing 8% phosphoric acid and 7% potash.

(See problems 12 and 15 in section 53, and Table 25.)

6. A field needs plant food in the following proportions: 3:7:5. Make a fertilizer of sodium nitrate, steamed bone meal and potassium sulphate to meet this need. How much sand is needed for a filler?

7. What is the value of a 3:8:6 commercial fertilizer based on the values given in problem 2?

8. How much can a farmer afford to pay for fresh farm manure when the above fertilizer can be secured as indicated in problem 7?

CHAPTER VII. CATTLE FEEDING

60. Cost of preparing Corn Meal

NOTE — Reports from the Illinois Experiment Station give the following figures on the cost of preparing feeds including the labor employed and the expense of wear on the machinery: shelling corn, \$.34 per ton; grinding corn for corn meal, \$1.20 per ton; and grinding ear corn for corn and cob meal, \$1.44 per ton. (Illinois Experiment Station Bulletin.)

1. When shelled corn costs 45¢ per bushel, what is the value of a ton of corn meal?

(Cost of corn plus the cost of grinding.)

2. 30.698 tons of corn meal costing \$13.699 per ton were fed in fattening 34 steers; how many bushels of corn were consumed?

3. What was the cost of the corn which was used in the preparation of the corn meal referred to in problem 2?

4. What is corn meal worth per ton when shelled corn is worth 65¢ per bushel?

5. What is the actual cost of corn-and-cob meal per ton when ear corn is worth 45¢ per bushel?

(70 lb. of ear corn per bushel.)

6. What is the value of ear corn per bushel when corn-and-cob meal is worth \$16 per ton?

7. What is corn meal worth per ton when ear corn is worth 48¢ per bushel?

8. A car is loaded with 66,000 lb. of shelled corn; what will it cost to convert this corn into corn meal?

9. If corn meal is worth \$13.00 per ton, what will the carload of corn bring when converted into corn meal?

10. Find the value of the carload of corn if it is converted into corn meal worth $16.50 per ton.

61. Milk Production on a Modern Dairy Farm

Record kept by the Illinois Cow Testing Association of the herd of 31 cows on the Funk & Wright Dairy Farm at McLean, Illinois, for the year beginning April 1, 1912, and ending March 31, 1913.

TABLE 35

No. months in milk	Breed	Age	No. of cow	Milk (lbs.)	Test in fat (per cent)	Return for $1 in feed	Yearly value of fat per cow	Value of feed
9............	J	8	1	5738	4.3	$1.32	$ 86	$65
12............	J	5	2	6818	4.6	1.62	109	57
11.5............	G	5	3	6361	4.3	1.46	95	65
10.5............	G	5	6	7719	4.9	1.87	131	70
11.5............	J	8	7	5520	5.3	1.64	102	62
9.5............	J	5	8	4509	3.6	1.00	57	56
11.5............	G	5	9	7407	4.3	1.58	112	71
12............	J	5	11	5925	5.2	1.79	107	63
11............	G	5	14	6450	5.5	1.92	125	65
9............	G	3	15	4463	4.3	1.14	67	69
11............	J	5	16	6709	5.1	1.89	121	64
9............	G	5	17	6626	3.8	1.36	82	65
11............	G	5	18	7602	4.3	1.66	82	65
11............	J	4	19	5241	5.2	1.54	96	62
12............	J	6	20	6878	3.9	1.45	93	64
11.5............	G	5	22	6273	4.4	1.54	99	64
12............	J	5	25	6717	5.2	1.80	121	67
10............	G	5	27	5587	5.3	1.62	104	64
11.5............	J	5	32	6206	4.3	1.51	94	62
10............	G	9	33	6424	4.5	1.52	102	67
11............	J	4	34	6402	4.5	1.59	100	63
10.5............	J	9	35	5487	4.4	1.31	85	63
9............	J	6	36	4737	5.4	1.39	89	64
12............	J	9	40	7104	4.7	1.68	116	69
11............	J	4	41	5714	5.1	1.64	102	62
11.5............	J	6	42	7788	4.6	1.74	122	69
11............	J	9	43	5274	4.8	1.40	88	63
9............	J	9	44	5151	4.3	1.22	78	64
11............	J	6	45	6341	4.3	1.45	96	66
5............	G	6	30	2676	5.6	1.23	53	43
8............	G	5	37	3462	4.0	.84	49	56

J = Jersey. G = Guernsey

1. Find the total pounds of milk produced by this herd for the entire year.

2. Find the average yield of milk per cow.

3. Determine the number of pounds of butter-fat produced by cows 1, 3, and 6.

(Amount of milk times rate of butter-fat.)

4. Find the amount of butter-fat produced by cows 7, 8, and 9 for the entire year.

5. What was the total value of the butter-fat produced by the herd for the year?

6. Find the average cost of feed per cow.

7. How much did the feed of the entire herd cost for the year?

8. How much did the value of the butter-fat exceed the cost of the feed?

9. There were 11,374.15 hours of man labor, 1670.45 hours of horse labor, and 1670.45 hours of machine labor spent on this herd of cows during the year. At an average of 16.9¢ per hour, how much was paid out for man labor?

10. At the rate of 11.27¢ per hour for horse labor, how much was expended for horse labor upon the herd?

11. If the average cost of the machine labor for the year was 2.15¢ per hour, what was the value of the machine labor?

12. Determine the entire cost of labor on the herd for the entire year.

13. What was the combined cost of labor and feed?

14. The interest on the amount of money invested in the cows was $224.06; what was the entire amount of money expended on the cows?

15. What was the average cost per quart of milk?

(One quart of milk weighs 2.18 lbs.)

16. What was the gain or loss on each quart of milk?

Optional Problems

17. Compare the income of the 6 best cows with that of the 6 poorest cows.

18. Compare the average milk production of the Guernseys with that of the Jerseys.

(In both cases the cows are "grades" and not pure-bred.)

19. Compare the average value of fat produced by the Jerseys with that produced by the Guernseys.

20. Compare the average per cent of fat produced by the Guernseys with that produced by the Jerseys.

21. What would have been the income from cow No. 6 had her milk been bottled and sold in the city market at 8¢ per quart?

22. The milk from the herd listed in the above table was sold to a milk company for 12¢ per gallon. The company bottled and sold it for 8¢ per quart. How much did the company receive for the total amount secured from the herd?

23. How much more did the milk company receive for the milk than they paid for it?

24. What was the average length of the lactation period of this herd.

(Months in milk.)

25. Compare the average per cent of fat produced by the 4, 5, and 6 year old cows, respectively.

26. Compare the average yearly income of the cows aged 4, 5, and 6, respectively.

27. If 82 lb. of butter-fat produces 100 lb. of butter, how much butter could have been made from the milk of cows 1, 3, and 6 for the year?

28. What is the value of this amount of butter if it sells for 30¢ per pound?

62. Value of a Balanced Ration

At the Illinois Experiment Station a herd of 18 cows was divided into two groups of nine cows each. In a preliminary test in which the cows were all fed the same ration, group 1 averaged 37.8 lb. of milk per cow daily, and group 2 averaged 36.18 lb. of milk per cow daily. The following table shows the proportion of the various feeds in the ration which was fed to the two groups, and the milk produced by each group.

TABLE 36

Feeds given daily to each cow in each Group

Group 1		Group 2	
Feed	Weight (lb.)	Feed	Weight (lb.)
Corn silage	30.0	Corn silage	30.0
Clover	8.0	Timothy hay	5.0
Gluten feed	4.6	Clover hay	3.0
Ground corn	3.33	Ground corn	8.0

Milk produced each week per Group

	Group 1 (lb.)	Group 2 (lb.)
1st week	2315.8	1947.6
2d week	2189.6	1811.8
3d week	2205.1	1729.4
4th week	2259.0	1652.9
5th week	2271.6	1581.1
6th week	2229.7	1537.0
7th week	2253.8	1421.8
8th week	2259.5	1467.1
9th week	2198.7	1423.4

	Group 1 (lb.)	Group 2 (lb.)
10th week	2121.3	1381.2
11th week	1990.0	1289.0
12th week	1986.6	1293.6
13th week	2000.6	1265.1
14th week	1989.1	1297.5
15th week	1961.8	1238.7
16th week	1976.1	1242.0
17th week	1818.8	1232.1
18th week	1905.8	1210.1
5 days	1359.2	808.4

1. Find the difference in the total amounts of milk produced by the two groups of cows for the entire period.

2. Find the difference in the average amount of milk per cow for the two groups.

3. Estimating this milk at $1.50 per 100 lb., how much did the income from group 1 exceed that from group 2?

4. How much did the average income per cow in group 1 exceed that in group 2 for the entire period?

5. This same report shows that owing to the character of the feed group 1 was fed 59,840 lb. for the entire period, and group 2 was fed 52,020 lb. Determine the difference in weight of the average daily ration per cow for each group.

6. Estimating the timothy hay at $15 per ton, the clover hay at $12 per ton, the gluten feed at $30 per ton, the silage at $3 per ton, and the ground corn at $18 per ton, what did the feed for each group of cows cost?

7. Estimating the milk at $1.50 per 100 lb., how much did the value of the milk exceed the difference in the cost of the feed?

8. Group 1 produced a total butter-fat of 1280.82 lb. and group 2 produced 825.95 lb. What fractional part of the weight of the milk was the weight of the butter-fat in each case?

9. What per cent of the weight of the milk was the weight of the butter-fat in each case?

10. Determine the value of the feed that was consumed by each group in the production of each 100 lb. of milk.

11. On the basis of prices quoted in problem 6, what was the average cost of milk per gallon for each group?

63. Determination of Nutritive Ratios

TABLE 37

The following table shows the amount of milk produced by each cow in groups 1 and 2 and the amount of nutrients consumed per 100 lb. of milk produced. (Illinois Experiment Station Bulletin 159.)

Group 1

Cow No.	Milk produced (lb.)	Nutrients consumed per 100 lb. milk		
		Digestible protein (lb.)	Carbohydrates (lb.)	Fat (lb.)
1	4083.1	5.75	33.52	2.39
2	4317.2	7.03	40.24	2.99
3	3243.6	10.37	59.74	4.38
4	4552.6	6.64	37.57	2.80
5	5140.2	6.28	35.86	2.66
6	4373.0	6.85	39.04	2.89
7	4404.9	7.85	44.58	3.31
8	5473.1	6.30	35.85	2.66
9	3806.3	7.01	39.96	2.96

Group 2

Cow No.	Milk produced (lb.)	Protein (lb.)	Carbohydrates (lb.)	Fat (lb.)
1	2008.5	6.30	62.52	3.18
2	2329.9	6.73	66.79	3.47
3	4123.2	4.77	46.99	2.43
4	3520.5	5.59	53.79	2.77
5	3913.1	4.91	48.52	2.52
6	3317.7	5.68	55.98	2.86
7	2487.7	7.36	72.85	3.73
8	2626.3	6.95	69.00	3.50
9	2512.9	5.63	55.67	2.82

NOTE — A *balanced ration* for various animals consists in a known relation or *ratio* which should exist between the proteins on the one hand and the carbohydrates and the fats on the other hand, in order to provide best health conditions. This ratio is known as the *nutritive ratio.* Since the nutritive ratio for various animals is known it is the business of feeders to proportion the various feeds so as to secure this ratio. The following formula is convenient for determining a nutritive ratio: —

$$\frac{\text{Carbohydrates} + 2\tfrac{1}{4}\text{ fats}}{\text{Proteins}} = \text{Nutritive Ratio;}$$

or,

$$\frac{C + 2\tfrac{1}{4}F}{P} = \text{N. R.}$$

The fats are multiplied by $2\frac{1}{4}$, since they contain $2\frac{1}{4}$ times as much energy as carbohydrates.

1. Determine the average amount of each nutrient consumed by each cow in group 1.

2. Determine the average amount of each nutrient that was consumed by each cow in group 2.

3. Determine the average amount carbohydrates consumed by group 1 per 100 lb. of milk produced.

4. Determine the nutritive ratio of the digestible nutrients consumed by each group of cows reported in the table.

64. Rations for Dairy Cows

TABLE 38

DIGESTIBLE NUTRIENTS REQUIRED BY A 1000-POUND COW GIVING DIFFERENT AMOUNTS OF MILK PER DAY

	Protein (lb.)	Fat[1] and carbohydrate (lb.)
10 lb. of milk testing 3% fat	1.23	9.35
20 " " " " " "	1.61	11.45
30 " " " " " "	2.03	13.58
40 " " " " " "	2.43	15.58
50 " " " " " "	2.88	17.80
60 " " " " " "	3.28	19.93

[1] Fats have been reduced to carbohydrate units. (See note attached to Table 37.)

	Protein (lb.)	Fat[1] and carbohydrate (lb.)
10 lb. of milk testing 4% fat	1.25	9.74
20 " " " " " "	1.77	12.26
30 " " " " " "	2.30	14.78
40 " " " " " "	2.80	17.31
50 " " " " " "	3.33	19.82
60 " " " " " "	3.80	22.37
10 " " " " 5% "	1.33	10.16
20 " " " " " "	2.00	13.08
30 " " " " " "	2.55	16.31
40 " " " " " "	3.10	18.93
50 " " " " " "	3.70	21.87
60 " " " " " "	4.32	24.81

NOTE — Since the above table is based upon a 1000-lb. cow, estimates upon cows above or below this weight should take into account .07 lb. of protein and .72 lb. of carbohydrates and fats, respectively, for each 100 lb. of increase or decrease from this weight.

1. Determine the nutritive ratios of the digestible nutrients required by a 1000-lb. cow while producing 10 lb. of milk, testing 4% butter-fat.

2. Give the nutritive ratios of the digestible nutrients required by a 1200-lb. cow which produces 20 lb. of milk, testing 3% butter-fat.

3. Give the nutritive ratio of the digestible nutrients required by an 800-lb. cow which produces 30 lb. of milk, testing 4% butter-fat.

4. Give the nutritive ratio of the digestible nutrients required by a 1100-lb. cow producing 30 lb. of milk, testing 4% butter-fat.

5. Find the nutritive ratio of the digestible nutrients required by a 1500-lb. Holstein cow producing 60 lb. of milk, testing 3% butter-fat.

6. Find the nutritive ratio of the digestible nutrients required by a 1500-lb. Holstein cow producing 60 lb. of milk, testing 4% butter-fat.

[1] Fats have been reduced to carbohydrate units. (See note attached to Table 37.)

65. Digestible Nutrients in Feeds

TABLE 39

(From Henry's *Feeds and Feeding*)

Name of feed	Pounds of dry matter per cwt.	Pounds of protein per cwt.	Pounds of carbohydrates per cwt.	Pounds of fat per cwt.
Concentrates —				
Dent corn	89.4	7.8	66.8	4.3
Corn meal	85.0	6.1	64.3	3.5
Corn-and-cob meal	84.9	4.4	60.0	2.9
Gluten meal	90.5	29.7	42.5	6.1
Gluten feed	90.8	21.3	52.8	2.9
Wheat	89.5	8.8	67.5	1.5
Red dog flour	90.1	16.2	57.0	3.4
Wheat middlings	88.8	13.0	45.7	4.5
Wheat bran	88.1	11.9	42.0	2.5
Rye	91.3	9.5	69.4	1.2
Barley	89.2	8.4	65.3	1.6
Emmer (speltz)	92.0	10.0	70.3	2.0
Oats	89.6	8.8	49.2	4.3
Ground oats	88.0	10.1	52.5	3.7
Oat meal	92.1	11.9	65.1	6.7
Canada field pea	85.0	19.7	49.3	0.4
Cowpea	85.4	16.8	54.0	1.1
Soy bean	88.3	29.1	23.3	14.6
Horse bean	88.7	23.1	49.8	0.8
Kafir corn	90.1	5.2	44.3	1.4
Ground Kafir corn heads	86.4	4.2	42.4	1.2
Sorghum seed	87.2	4.5	61.1	2.8
Broom corn seed	87.2	4.6	42.2	1.5
Millet seed	87.9	7.1	48.5	2.5
Flax seed	90.8	20.6	17.1	29.0
Linseed meal (old process)	90.2	30.2	32.0	6.9
Linseed meal (new process)	90.0	31.5	35.7	2.4
Cotton seed	89.7	12.5	30.0	17.3
Cotton-seed meal	93.0	37.6	21.4	9.6
Cocoanut cake	89.7	15.4	41.2	10.7
Sunflower seed	91.4	14.8	29.7	18.2
Dried brewers grain	91.3	20.0	32.2	6.0
Wet brewers grain	23.0	4.9	9.4	1.7
Malt sprouts	90.5	20.5	46.0	1.4
Wet beet pulp	10.2	0.5	7.7	..
Dried beet pulp	91.6	4.1	64.9	..
Sugar beet molasses	79.2	4.7	54.1	..
Cows milk	12.8	3.4	4.8	3.7
Skim milk	9.4	2.9	5.3	0.3
Buttermilk	9.9	3.8	3.9	1.0
Cotton-seed hulls	88.9	13.0	33.2	1.7

Name of feed	Pounds of dry matter per cwt.	Pounds of protein per cwt.	Pounds of carbohydrates per cwt.	Pounds of fat per cwt.
Whey	6.2	0.6	5.0	0.2
Meat Scrap	89.3	66.2	..	13.4
Dried blood	91.5	70.9	..	2.5
Tankage	89.2	50.1	..	11.6
Roughages, Dried —				
Corn fodder (ears on)	57.8	2.5	34.6	1.2
Corn stover (ears off)	59.5	1.4	31.2	0.7
Timothy hay	86.8	2.8	42.4	1.3
Orchard grass	90.1	4.9	42.4	1.4
Red top	91.1	4.8	46.9	1.0
Ky. blue grass	86.0	4.4	40.2	0.7
Bermuda grass	92.0	6.4	44.9	1.6
Oat hay	86.0	4.7	36.7	1.7
Buffalo grass	85.0	3.0	42.0	1.8
Red clover	87.7	7.1	37.8	1.8
Mammoth clover	78.8	6.2	34.7	2.1
Alsike clover	90.3	8.4	39.7	1.1
White clover	90.3	11.5	42.2	1.5
Crimson clover	90.4	10.5	34.9	1.2
Sweet clover	92.1	11.0	36.7	0.5
Soy bean	88.2	10.6	40.9	1.2
Cowpea	89.5	9.2	39.3	1.3
Alfalfa	91.9	10.5	49.5	0.9
Wheat straw	90.4	0.8	35.2	0.4
Rye straw	92.9	0.7	39.6	0.4
Oat straw	90.8	1.3	39.5	0.8
Barley straw	85.8	0.9	49.1	0.6
Roughages, Green —				
Ky. blue grass	34.9	2.8	19.7	0.8
Rye forage	23.4	2.1	14.1	0.4
Oat forage	25.0	2.6	11.0	0.6
Red clover	29.8	2.9	13.6	0.7
Mammoth clover	20.0	2.0	9.1	0.2
Alsike clover	25.2	2.6	11.4	0.5
Crimson clover	19.1	2.4	9.1	0.5
Sweet clover	20.0	2.5	8.4	0.4
Alfalfa	28.2	3.6	12.1	0.4
Cowpea	16.4	1.8	8.7	0.2
Soy bean	24.9	3.1	11.0	0.5
Canada field pea	15.3	1.8	6.9	0.3
Potato	20.9	1.1	15.7	0.1
Mangel	9.1	1.0	5.5	0.2
Flat turnip	9.9	0.9	6.4	0.1
Corn silage	26.4	1.4	14.2	0.7
Corn fodder	20.7	1.0	11.9	0.4

NOTE — The figures in the columns above represent the number of pounds per hundredweight of the material.

Optional Problems

1. How much corn meal is required to supply the necessary protein for a 1000-lb. cow producing 30 lb. of milk, testing 4% butter-fat, if she is fed 10 lb. of alfalfa hay, 35 lb. of corn silage, and 3 lb. of wheat bran daily?
(See Table 39.)

2. If corn-and-cob meal is substituted for corn meal, how much is required to supply the needed protein?

3. How much corn meal is required to supply the needed protein in a ration for a cow giving 40 lb. of milk, testing 4% butter-fat; alfalfa hay 10 lb., corn stover 5 lb., silage 35 lb.; linseed meal 1.5 lb., and wheat bran 5 lb.?

4. How much gluten feed is needed to supply the protein for a 1000-lb. cow producing 30 lb. of milk, testing 3% butter-fat; clover hay 10 lb., corn stover 6 lb., corn silage 35 lb., wheat bran 4 lb., and cotton-seed meal .75 lb.

5. To 10 lb. of timothy hay and 20 lb. of corn stover, add 4 lb. of corn meal, and 5 lb. of wheat bran and enough cotton-seed meal to supply the protein for a 1000-lb. cow producing 30 lb. of milk, testing 4% butter-fat.

6. If 15 lb. of clover hay, 35 lb. of corn silage, and 5 lb. of corn meal are fed daily to a 1000-lb. cow producing 50 lb. of 4% milk per day, how much ground oats and cotton-seed meal, fed in the proportion of 4 lb. of oats to 1 lb. of meal, are needed to balance the protein?

7. To 10 lb. of corn stover, 10 lb. of clover hay, and 35 lb. of corn silage, add sufficient quantities of corn meal, ground oats, wheat bran, and cotton-seed meal, in the proportion of 1:1:1:.5, respectively, to balance the protein for a cow weighing 1000 lb. and producing 30 lb. of milk, testing 4% butter-fat.

8. To roughages, consisting of 10 lb. of alfalfa hay, 6 lb. of corn stover, and 35 lb. of silage, add a grain mixture of corn meal, wheat

bran, and linseed meal in the following proportions — 1:1:.1:.5 — which will balance the protein for a 1000-lb. cow producing 30 lb. of milk, testing 3% butter-fat.

9. 10 lb. of clover hay, 5 lb. of corn stover, and 35 lb. of corn silage are fed to a 1000-lb. cow producing 40 lb. of milk, testing 4% butter-fat. Determine the exact amount of corn meal, wheat bran, gluten feed, and cotton-seed meal required to prepare a grain mixture in the following proportions — 1:1:1:.5 respectively — which will balance the protein in this ration.

10. At the South Carolina Experiment Station 5.1 lb. of cotton-seed meal were fed in conjunction with 34.8 lb. of corn silage as a daily ration per cow. Determine the silage and cotton-seed meal required to feed a herd of 20 cows for a period of 180 days.

11. Determine the amount of wheat bran required to substitute the protein in the cotton-seed meal provided for in the above ration.

12. On the basis of local prices determine the relative cost of the two rations as provided for in problems 10 and 11.

13. A daily ration per cow, composed of 7 lb. of corn stover, 40 lb. of corn silage, 4.5 lb. of wheat bran, 4.5 lb. of dried brewers' grain, and 2 lb. of cotton-seed meal, was fed at the New Jersey Experiment Station. On the basis of local prices determine the cost of furnishing this ration to a herd of 15 cows for 180 days.

14. In the New Jersey Experiment Station where the above ration was fed, the average daily yield of milk per cow was 37.3 lb. and the average butter-fat was 1.13 lb. Determine the quantity of milk and butter-fat produced by a herd of 15 cows for 150 days, on the basis of this average.

15. On the basis of local prices determine the relative values of foods fed and of the milk produced as provided in problems 13 and 14.

66. An Experiment with Gluten Feed and Bran

At the Vermont Experiment Station 2 cows were fed alternately on the following rations: No. 1, gluten feed 4 lb., corn meal 4 lb., cut hay 8 lb., and silage at will; No. 2, wheat bran 4 lb., corn meal 4 lb., cut hay 8 lb., and silage at will. The average daily production of cows while on ration 1 was 21.5 lb. of milk, and 1.08 lb. of butter-fat, and when on ration 2, the daily production was 18.7 lb. of milk and 0.93 lb. of butter-fat. (From Henry's *Feeds and Feeding*, p. 398.)

1. What was the per cent of butter-fat produced by each ration?

2. What was the weekly production of butter-fat from each ration?

3. What was the per cent of increase in milk and butter-fat due to the gluten feed ration?

67. Experiment with Cotton-Seed Meal and Linseed Meal

At the Pennsylvania Experiment Station 9 cows were fed on a ration consisting of 5.3 lb. of cotton-seed meal, 6.7 lb. of chopped wheat, and 9.3 lb. of corn stover. Later the ration was changed to the following; 6.0 lb. of old-process linseed meal, 9.0 lb. of chopped wheat, and 9.3 lb. of silage. The average daily milk yield for the first ration was 16.3 lb. of milk and .7 lb. of butter-fat, while for the second ration the daily yield of milk was 15.1 lb. and of butter-fat .78 lb. (Henry's *Feeds and Feeding*, p. 399.)

1. What was the per cent of increase in the milk production while the cows were fed ration 1 as compared with that while fed on ration 2?

2. What was the per cent of butter-fat while fed ration 2 as compared with that while fed on ration 1?

3. What was the per cent of butter-fat in the milk produced by each ration.

68. Experimental Feeding of Steers

An experiment was carried on at the Illinois Experiment Station to demonstrate the relative value of two feeds for the fattening of beef

cattle. Lot 1 was fed corn, timothy hay, and corn stover; and lot 2 was fed gluten meal, corn, timothy hay, and corn stover. The feeds were valued as follows: corn 35¢ per bushel, gluten meal $29 per ton, timothy hay $10 per ton, corn meal $13.34 per ton, corn-and-cob meal $10.50 per ton, and corn stover $3 per ton.

Lot 1 consisted of 12 steers whose combined weight was 11,610 lb. Lot 2 consisted of 12 steers whose combined weight was 11,702 lb. (Mumford, *Beef Production.*)

1. What was the cost of each lot of steers at $3.80 per cwt.? What was the average cost per steer?

2. During the test, lot 1 was fed 225.7 bu. of corn, 7.59 tons of corn-and-cob meal, 1.41 tons of corn meal, 5.37 tons of timothy hay, 3.17 tons of corn stover. What was the cost of the food?

3. $13.57 additional was expended for feeding lot 1 the last week of the test, and $30 was expended on it for freight. What was the total expense of lot 1 in Chicago?

4. Lot 1 weighed 14,063.04 at the end of the test, and brought $5.35 per cwt. on the market. What did the sale of lot 1 amount to?

5. What was the net gain on lot 1?

6. During the fattening period lot 2 was fed 138.27 bu. of corn, .64 tons of corn meal, 6.02 tons of corn-and-cob meal, 2.09 tons of gluten meal, 5.96 tons of timothy hay, and 3.18 tons of corn stover. What was the cost of the combined feed of lot 2?

7. $15.42 was expended for feed in holding lot 2, and $30 was expended for freight and incidental expenses. What was the entire cost of fattening and putting lot 2 on the market?

8. The 12 steers in lot 2 weighed 14,880 lb. and sold for $5.80 per cwt. What was the gross income from lot 2?

9. What was the net income from lot 2?

Optional Problems

10. Determine the excess of the sales over the purchasing prices in lots 1 and 2.

11. What was the average net income per steer in each lot?

12. Work out a statement of expenses and receipts for each lot for purposes of comparison. Which lot gained the most? How much was gained per steer by the use of the cheaper feed?

13. 34 "good-to-choice," fleshy, 3-year-old steers were purchased in the Union Stock Yards in Chicago for the Illinois Experiment Station. They were purchased on August 22 and taken to Champaign and fed until November 25. The total weight of the steers on their arrival at the Illinois Station was 36,490 lb. What was the total cost at $4.25 per cwt.?

14. $20 was paid for commission and $41.88 for freight. What was the entire cost of these steers?

15. During the time at the Experiment Station the steers were fed 30.608 tons of corn meal at $13.699 per ton, 14.589 tons of oil meal at $28 per ton, 10.175 tons of clover hay at $8 per ton. What was the total cost of the feed?

16. What was the entire cost of these steers when they were ready for the market in November?

17. After the feeding season the 34 steers weighed 44,650 lb. and were sold for $5.60 per cwt. The freight and commission amounted to $73.88. What was the income from the steers after deducting the freight and commission?

18. What was the net profit or loss on the entire lot?

19. What was the net profit or loss per steer?

69. Short-fed Steers

The Illinois Experiment Station bought on the Chicago market 130 choice feeding steers averaging 1006 lb. at an average cost of $4.267 per cwt. The freight rate to Champaign, 128 miles from Chicago, on stock cattle was 7.7¢ per cwt., being $\frac{3}{4}$ of the fat cattle rate. The shrinkage per steer from market to feed lot was 53.4 lb. The steers were fed for

6 months and gained 480 lb. each feed-lot weights, at a cost of 7.23¢ per lb. (not crediting pork produced) on a basis of corn worth 35¢ per bushel, clover hay $8 per ton, and linseed oil meal $24 per ton.

When shipped to Chicago in June they shrank 22.5 lb. per steer, weighing when sold an average of 1410 lb. They cost the Experiment Station $5.79 per cwt. and sold for $6.10 per cwt. (Mumford, *Beef Production.*)

1. Determine the total loss from shrinkage in shipping from Chicago to Champaign.

2. Find the freight cost on the feeding steers.

3. What was the cost per steer in the yards at Champaign?

4. What was the average gain per steer when returned to the stock yards at Chicago over the previous stock yards weights?

5. What did this gain cost per steer?

6. How much did the fattened steers bring on the Chicago market?

7. Find the amount of the freight on the fattened cattle.

8. If the steers dressed 60% of their gross weight, how many pounds of meat did the entire lot dress?

70. Rations for Beef Cows

At the Illinois Experiment Station, Mumford made a comparison, covering a period of 140 days, of corn silage, shock corn, and corn stover to determine their relative value for maintaining beef breeding cows. The feeds were charged to the cows at the following prices: corn silage $3.34 per ton, shock corn $5.59 per ton, corn stover $2.25 per ton, shredded stover $2.25 per ton, clover hay $8 per ton, and oat straw $1.50 per ton. Each lot was fed a ration made up of the following feeds: lot 1, corn silage, clover hay, and oat straw; lot 2, shock corn, clover hay, and oat straw; and lot 3, clover hay, oat straw, and shredded stover. (Illinois Experiment Station Bulletin 3.)

1. The cows in lot 1 averaged 860.33 lb. at the beginning, and 1010.43 lb. at the end of the period. What was the daily gain per cow?

2. The feed eaten daily per cow in lot 1 was as follows: silage 16.65 lb., clover hay 3.50 lb., and oat straw 9.56 lb. Determine the average cost per cow for the feed given lot 1.

3. What was the average cost per pound of weight gained by lot 1?

4. The cows in lot 2 averaged 858.5 lb. at the beginning, and 964.69 lb. at the end of the period. What was the average daily gain per cow?

5. The average daily feed per cow in lot 2 was as follows: shock corn 8.70 lb., clover hay 3.50 lb., and oat straw 10.83 lb. What was the average cost per cow for the feed given lot 2?

6. What was the average cost per pound of gain in this lot?

7. The cows in lot 3 averaged 859.83 lb. at the beginning, and 916.36 lb. at the end of the experiment. What was the daily gain per cow?

8. The average daily feed eaten per cow in lot 3 was as follows: corn stover (first 42 days) 21.67 lb., shredded stover (last 68 days) 10.29 lb., clover hay 1.56 lb., and oat straw 8.19 lb. What was the average cost per cow for the feed given to lot 3?

9. Determine the average cost per pound of weight gained by this lot.

Optional Problems

10. On the basis of the average cost per pound of weight gained by the three rations fed, how much will it cost a cattle-breeder to increase the weight of a herd of 20 cows from 950 lb. to 1000 lb., if he uses ration 1? Ration 2? Ration 3?

11. Not considering the gains in live weight, which is the most economical ration?

12. How much will it cost a farmer to winter a herd of 50 cows for 180 days on the cheapest of these rations?

13. How much will it cost to winter the same herd for 180 days on the most expensive of the three rations?

71. Cotton-Seed Meal for Cattle

Curtis at the North Carolina Experiment Station carried on experiments to determine the relative amounts of cotton-seed meal that can be safely fed to fattening cattle. The following table shows the amounts of each feed fed to the various lots during the experimental period.

TABLE 40

Period 122 days

Lot 1 was fed	7.53 lb. cotton-seed meal, 26 lb. cotton-seed hulls.
Lot 2 was fed	6.05 lb. cotton-seed meal, 12.7 lb. corn stover, 13.8 lb. corn silage.
Lot 3 was fed	7.53 lb. cotton-seed meal, 12.7 lb. corn stover, 13.8 lb. corn silage.
Lot 4 was fed	9.07 lb. cotton-seed meal, 12.7 lb. corn stover, 13.8 lb. corn silage.
Lot 5 was fed	7.53 lb. cotton-seed meal, 30.6 corn silage.

1. The feeds were rated as follows: cotton-seed meal $26 per ton; cotton-seed hulls $6 per ton; corn silage $3 per ton, and corn stover $10 per ton. What was the average cost of food per steer in each lot?

2. The average daily gain per steer in lot 1 was 1.28 lb. Determine the final weight of a steer which made an average daily gain, if he weighed 900 lb. at the beginning?

3. The average initial weight of the steers in lot 1 was 945.7 lb. The initial value per cwt. was $3.86. What was the initial value per steer?

4. What was the final average weight per steer?
(See problem 2.)

5. The value of the steers at the end of the fattening period was \$5.50 per cwt. What was the average value per steer?

(See problems 2 and 3.)

6. Determine the average net profit per steer in lot 1.

7. Lot 2 averaged 1.46 lb. gain daily per steer. The average initial weight was 919.3 lb. What was the average weight at the end of the test?

8. At an average initial cost of \$3.86 per cwt. and a final value of \$5.75 per cwt., what was the average gross gain per steer?

9. After deducting the cost of the feed, what was the average net gain per steer in lot 2?

10. The average initial weight of lot 3 was 893.6 lb. and the average initial cost was \$3.86 per cwt. What was the average initial cost per steer?

11. The steers in lot 3 gained on an average 1.6 lb. daily. What was the average weight of the steers at the end of the period?

12. What was the cost per cwt. of gain?

13. The final value of the steers in lot 3 was \$5.75 per cwt. What was the average net profit per steer?

14. The average initial weight of the steers in lot 4 was 905 lb. and the average initial cost was \$3.86 per cwt. Determine the average cost per steer.

15. The average daily gain per steer in lot 4 was 1.64 lb. What was the average gain for the entire period?

16. The final value of the steers in lot 4 was \$5.75 per cwt. What was the average net profit per steer?

17. The average initial weight of the steers in lot 5 was 890 lb. and the initial cost was \$3.86 per cwt. What was the cost per steer?

18. The average daily gain per steer in this lot was 1.69 lb. What was the final average weight per steer?

19. The average value of these steers at the end of the fattening period was $6 per cwt. What was the average net profit per steer?

Optional Problems

20. Compare the net gains of the several lots.

21. From the table on the composition of feeds determine the amount of dry matter, protein, fat and carbohydrates in the ration fed to the steers in lot 1.

22. What was the nutritive ratio of the ration fed to lot 1? (See note, section 63.)

23. Give the average amount of protein consumed per steer during the feeding period.

24. Find the average amount of protein per 1000 lb. of initial weight fed to an average steer in lot 2 at the North Carolina Experiment Station.

25. Find the average amount of carbohydrates fed to an average steer in lot 2.

26. What was the average amount of dry matter fed to an average steer in lot 2.

27. How much linseed meal is required to furnish an amount of protein equal to that supplied by the cotton seed meal, which was fed daily to each steer in lot 2?

28. How much alfalfa hay is required to supply the protein in the daily ration fed to each steer in lot 2?

72. The Composition of Milk

Wing, of the Cornell Experiment Station, gives the average composition of butter as follows:

TABLE 41

Fat	85%
Casein	1%
Salt	3%
Water	11%

1. The Holstein cow, Banostine Belle De Kol, produced in one year 27,404.4 lb. of milk containing 1058.34 lb. of butter-fat. How much butter would this milk produce?

(Consider the amount of butter-fat equal to 85% of the butter it will produce.)

2. At 30¢ per pound for butter-fat, what was the yearly income from this cow?

3. If a quart of milk weighs 2.18 lb., how many quarts of milk did this cow give in one year?

4. If the milk was sold at 10¢ per quart, what was the income from this cow?

5. A butter maker has a churning of 345 lb. of butter. How much salt should he add to make the butter contain the average amount of salt?

6. A grocer bought 115 lb. of creamery butter containing 85% fat and 1% casein, and 115 lb. of country butter containing 80% fat and 6% casein. He paid 30¢ for the creamery butter and 25¢ for the country butter. What did the butter-fat cost per pound in each case?

Optional Problems

7. The Jersey cow, Jacoba Irene, produced in one year 17,253 lb. of milk containing 952 lb. 15.4 oz. of butter-fat. How many pounds of butter could have been made from this fat?

(Use percentage given in Table 41.)

8. How many pounds of salt are required to salt the butter made from this amount of butter-fat?

9. The Holstein cow, Daisy Grace De Kol, produced in one year 27,718.3 lb. of milk containing 963.22 lb. of butter-fat. How much butter could have been made from this amount of fat? What will this amount of milk bring at 8¢ per quart?

10. If an equal amount of milk is sold in the city market for 10¢ per quart, what will it bring?

11. If an equal amount of butter-fat is sold in the form of cream, which is one fourth butter-fat, what will the cream need to sell for per pint to bring an amount equal to that secured for the milk at 10¢ per quart?

12. How much will the butter need to bring per pound to equal the value of the milk at 10¢ per quart?

13. The Jersey cow, Sophie 9th, of Hood Farm, produced in one year 15,099.3 lb. of milk containing 931.9 lb butter-fat. What was the value of the milk of this cow at 10¢ per quart?

14. If the milk from this cow had been sold in the form of butter-fat at 30¢ per pound, how much income would it have brought?

15. How many pints of cream, one fifth butter-fat, can be sold from the butter-fat equal to that produced by this cow?

16. What was this cream worth per pint on the basis of milk worth 10¢ per quart?

17. The Guernsey cow, Spotswood Daisy Pearl, produced in one year 18,108.2 lb. of milk containing 951.38 lb. of butter-fat. What was the income from this cow if her milk was made into butter and sold at 35¢ per pound?

18. The Ayrshire cow, Lilly of Willowmoor, produced in one year 22,106 lb. of milk containing 888.7 lb. of butter-fat. Determine the per cent of butter-fat.

19. On the basis of Table 41 determine the amount of butter that this amount of butter-fat will make.

73. Rations for Milk Cows

The New Jersey Experiment Station recommends the following rations for a 1000-lb. dairy cow giving 25 lb. of 4% milk.

TABLE 42

	Pounds	Price per ton
Ration 1 —		
Alfalfa hay	10	$24.00
Corn silage	36	3.00
Corn stover	8	10.00
Corn-and-cob meal	4	20.00
Dry brewers' grain	1	30.00
Ration 2 —		
Mixed hay	10	$25.00
Corn silage	36	3.00
Corn stover	8	10.00
Corn-and-cob meal	2	20.00
Dry brewers' grain	2	30.00
Cotton-seed meal	1.5	33.00
Ration 3 —		
Corn stover	12	$10.00
Beet pulp	7	25.00
Dry brewers' grain	2	30.00
Wheat bran	2	27.00
Cotton-seed meal	1	33.00
Corn meal	5	33.00
Ration 4 —		
Mixed hay	10	$25.00
Corn stover	8	10.00
Beet pulp	6	25.00
Corn-and-cob meal	3	20.00
Dry brewers' grain	2	30.00
Cotton-seed meal	1.5	33.00

1. Determine the cost per day of each ration.

2. What will it cost to feed a herd of 20 cows for an entire year on ration 4 set forth in the above table?

74. Roughages for Milk Cows

The following tabulated data are the result of an experiment carried on at the North Carolina Experiment Station to determine the relative value of corn stover and cotton-seed hulls as roughage for cows. Seven grade cows, from 2 to 3 months in lactation, were fed during three periods of 22 days each. The daily grain ration was the same for all cows throughout the three periods and consisted of 4 lb. of cotton-seed meal, 2 lb. of dried brewers' grain, and 1 lb. of linseed meal. All cows received 8 lb. of

this grain mixture per day, except cows No. 6 and No. 7, which received 10 lb. each, daily. Each cow received 14 lb. of roughage per day except cows No. 1 and No. 4, each of which received 16 lb.

TABLE 43

Cow No.	Period	Weight of milk (lb.)	Per cent of fat	Average weight of cows during test (lb.)
1.........	1. Stover	335.2	5.0	660
	2. Hulls	332.8	5.4	656
	3. Stover	316.7	5.4	639
2.........	1. Stover	400.2	4.1	687
	2. Hulls	342.0	4.2	687
	3. Stover	316.6	4.2	672
3.........	1. Stover	405.4	4.4	587
	2. Hulls	353.4	4.9	571
	3. Stover	340.3	4.8	569
4.........	1. Stover	434.4	4.5	824
	2. Hulls	353.4	4.7	794
	3. Stover	340.3	4.6	767
5.........	1. Stover	468.7	4.5	805
	2. Hulls	409.8	4.5	785
	3. Stover	363.4	4.6	806
6.........	1. Stover	359.6	4.4	784
	2. Hulls	378.5	4.8	769
	3. Stover	262.4	4.7	778
7.........	1. Stover	335.6	5.2	683
	2. Hulls	322.9	5.4	657
	3. Stover	284.3	5.7	758

1. Determine the amount of butter-fat produced by cow No. 1 during each period of the test.

2. Find the total amount of butter-fat produced by cow No. 2 during the entire test.

3. What was the total amount of milk produced by all the cows during the entire test?

4. Determine the average amount of milk produced daily per cow when fed corn stover.

5. Obtain the average amount of milk produced daily per cow when fed cotton-seed hulls.

Optional Problems

6. Determine the average amount of butter-fat produced daily by cow No. 1 when fed corn stover. When fed cotton-seed hulls.

7. If butter was 85% fat, how much butter did cow No. 1 produce during the time she was fed on corn stover?

8. What was the average amount of butter produced daily by cow No. 1 when fed on cotton-seed hulls? When fed on corn stover?

9. Determine the amount of protein, carbohydrates, and fat fed to cow No. 5 per day, when fed hulls.

10. Determine the nutritive ratio of the average ration fed to each cow.

11. Determine the amount of butter produced by cow No. 4 during the three periods if it contained 85% butter-fat.

75. Testing the Milk Production of Cows

The following table shows the results obtained at the Nebraska Experiment Station by testing cows of widely different productions of milk. (Nebraska Experiment Station Bulletin 129, by Haecker and Frandsen.)

TABLE 44

Name or No. of cow	Months in lactation	Pounds of milk	Average test of butter-fat (per cent)	Value of fat	Total cost of feed per year
No. 36..........	11	12959	3.46	$162.50	$38.92
No. 28..........	12	4362	4.38	71.31	28.22
Lady...........	11	10005	3.41	118.16	38.59
Kate...........	12	1797	2.82	17.41	31.14

1. What was the average daily yield of milk from each of the cows No. 36, and No. 28?

(30 days per month.)

2. How much butter-fat did cows No. 28 and No. 36 produce per day during the entire lactation period?

3. Find the profit of each of these cows.

4. How much income was received from cow No. 28 for each dollar's worth of feed consumed by her?

5. How much butter-fat did Lady and Kate each produce?

6. How much did this butter-fat cost per pound?

7. Determine the profit for each of the cows referred to in problem 5. How much were the returns in each case for each dollar's worth of feed?

8. How much did the profit of cow No. 36 differ from that of the cow Kate?

Optional Problems

9. Find the yearly profit on a herd of 25 cows yielding on an average as much milk and butter-fat as did cow No. 36?

10. What is the yield in milk and butter-fat of a herd of 25 cows whose average daily yield is equal to that of the cow Kate?

11. Determine the difference in the profit for one year of the herds mentioned in problems 9 and 10.

76. Roughages for Steers

An experiment was carried on by Snyder at the Nebraska Sub-Station at North Platte, to test the relative value of different roughages in the feeding of steers. The six lots were put on feed December 3, and taken off feed August 5, three years later (976 days in all). The table below summarizes the essential results. (Nebraska Experiment Station Bulletin 117.)

TABLE 45

Lot No.	1	2	3	4	5	6
Forage rations	Alfalfa	Prairie	Cane	Alfalfa and prairie hay	Alfalfa and cane	Prairie hay and cane
Av. first weight of steers (lb.)	446	450	452	451	451	449*
Av. last weight of steers (lb.)	1215	1092	1175	1251	1164	..
Feed eaten per steer during test (tons)	5.2	4.12	5.19	5.19	4.73	..
Cost of feed —						
Pasture	$3.11	$3.11	$10.35	$10.35	$10.35	..
Grains	31.19	20.99	3.11	3.11	3.11	..
Forage	10.35	10.35	21.63	20.37	21.97	..
Interest at 6% on total investment (computed at end of each period)	5.13	4.59	4.75	5.11	4.72	..
Value per 100 lb. (Omaha estimate)	4.55	4.25	4.50	4.70	4.50	..

* Record on lot 6 not complete.

1. Find the average gain of each steer for the entire period.

2. How much was the average daily gain per steer?

3. What was the average cost of feeding the steers in each lot if the interest is included?

4. There was an average shrinkage of 3.1% in transporting the steers from North Platte to the market at Omaha. What was the average weight at Omaha of the steers in each lot?

5. The cost of shipping and selling these steers was $.281 per cwt. (Omaha weight). Find the average freight cost of the steers in each lot.

6. What was the average total cost per steer when sold at Omaha?

CHAPTER VIII. SWINE FEEDING

77. Feeding Corn to Swine while on Pasture

The Nebraska Experiment Station made a series of comparative tests on the various amounts of corn fed to hogs running in alfalfa pasture. The average results from three of the lots are tabulated below.

TABLE 46

Lot No.	88	89	90
Period	April 25 to June 20	April 25 to July 11	April 25 to July 11
No. of days in period	56	76	76
Av. 1st wt. in lb	148	147	139
Av. last wt. in lb	225	225	178.5

1. The hogs in lots 88 and 89 were kept until they averaged 225 lb. each. What was the average daily gain per hog?

2. On the basis of the rate of average increase per hog, how long would it have been necessary to feed lot 90 to bring the average up to 225 lb.?

3. Lot 88 was fed 2.91 lb. of ear corn daily per 100 lb. of live weight. The average weight increased from 148 lb. at the beginning to 225 lb. at the end of the period. How much corn was fed per average hog during the test?

4. It was estimated that the alfalfa pasture eaten by the hogs in lot 88 was worth 4¢ per day, and that the corn was worth 47¢ per bushel. What was the average cost of the feed for each hog in this lot, from April 25 to June 20?

5. What per cent of the total cost of feeding was the cost of the pasture?

6. What was the cost of the feed per 100 lb. of gain in lot 88?

7. The hogs in lot 89 were fed on an average, 1.9 lb. of corn daily for each 100 lb. of live weight. What was the average amount of corn fed to these hogs daily?

8. With ear corn worth 47¢ per bushel and alfalfa pasture estimated at 6¢ per day for each hog, what was the average cost of feeding each of these hogs from April 25 to July 11?

Optional Problems

9. What was the average cost of feed per 100 lb. of gain for each hog in lot 89?

10. What per cent of the entire cost of feed for lot 89 was the cost of the alfalfa?

11. Each hog in lot 90 was charged 8¢ a day for alfalfa. Find the average cost per hog for the alfalfa eaten during this period.

12. What was the average cost of feed per 100 lb. of gain in lot 90?

13. Compare the results of problems 6, 9, and 12, and note the most economical method of feeding hogs on alfalfa pasture.

14. If lots 88, 89, and 90 had contained 100 hogs each, how much would all the food have cost per lot, respectively?

(See problems 4, 7, and 9.)

78. Feeding Corn and Cane Seed to Swine

The results of an experiment carried on at the Nebraska Experiment Station to demonstrate the relative value of rations composed of corn and alfalfa, cane seed and alfalfa, and these three feeds taken together, are tabulated below. There were ten pigs in each lot and the test lasted through a period of 63 days.

TABLE 47

Lot No.	72	73	86	87
Ration	Corn	Corn, chopped alfalfa	Cane, chopped alfalfa	Corn, cane, chopped alfalfa
Av. first wt. (lb.)	143.5	141.5	140.0	139.5
Av. last wt. (lb.)	245.5	248.0	212.5	229.5
Amt. of feed (lb.)				
1. Corn	481.2	411.0	..	198.9
2. Cane	..	..	394.56	198.9
3. Chopped alfalfa	..	45.78	43.8	44.2

1. What was the average daily gain per pig under each system of feeding?

2. With ear corn worth 47¢ per bushel, chopped alfalfa worth $10 per ton, and cane seed worth 50¢ per bushel, what was the cost of the ration fed to lot 73?

3. Find the average cost per cwt. of gain for lot 73.

4. What per cent of each ration was alfalfa?

5. What per cent of each ration was corn?

6. What per cent of the ration fed to lot 87 was cane?

7. With shelled corn worth 47¢ per bushel, what was the cost of the ration fed to lot 72?

8. Find the average cost per cwt. of gain for lot 72.

79. Feeding Shelled Corn to Swine

The following data on shelled corn for feeding swine were tabulated from the bulletin reports of eight American Experiment Stations. (Henry's *Feeds and Feeding.*)

TABLE 48

Station reporting	No. of pigs	No. of days fed	Av. weight at beginning (lb.)	Av. daily gain (lb.)	Pounds of corn per 100 lb. gain
Alabama..........	3	42	51	0.4	586
Colorado..........	4	101	95	0.7	540
Illinois............	2	42	210	1.3	500
Kansas...........	3	84	123	1.2	479
Kentucky.........	4	70	139	0.7	587
Missouri..........	4	78	150	1.9	482
Nebraska.........	6	56	170	1.2	530
West Virginia......	3	28	239	1.7	579

1. Find the amount of gain that was produced on one bushel of corn at each station.

2. If hogs are worth 7¢ per pound, what is the value of corn on the basis of results obtained at the Colorado Station?

3. When corn is worth 60¢ per bushel, what are live hogs worth on the basis of results obtained at the Kansas Station?

4. On the basis of the average gain per bushel of corn at the Missouri Station, what will it cost to increase the weight of a hog from 100 lb. to 145 lb., if corn is worth 65¢ per bushel?

5. A farmer is feeding 300 hogs which average 125 lb. each. How much corn is needed to make these hogs weigh 300 lb. each, if they gain as fast as those reported by the Nebraska Station?

6. If 200 hogs averaging 150 lb. are fed according to the Illinois report, how much corn is required to double their weights? To increase their weights by 200 lb.?

80. Feeding Corn and Alfalfa to Swine

An experiment for fattening hogs was carried on at the Nebraska Experiment Station to test the relative value of chopped alfalfa, and alfalfa meal with different proportions of corn.

TABLE 49

Lot No.	66	68	69	70	71
Ration	100% corn	90% corn 10% C. A.	75% corn 25% C. A.	90% corn 10% A.M.	75% corn 25% A.M.
No. of pigs in lot	10	10	10	10	10
Av. first wt. (lb.)	168.6	168.5	168.5	168.5	168.5
Av. last wt. (lb.)	225.0	225.5	208.0	232.7	216.0
Pounds of corn	377.0	194.06	141.99	211.86	150.575

1. Lots 68, 69, 70, and 71 were fed for a period of 34 days. What was the average daily gain per hog in each lot?

2. At 47¢ per bushel, what was the cost per hog of the ear corn which was fed to each lot?

3. If alfalfa meal was valued at $15 per ton, and chopped alfalfa at $10 per ton, what was the average cost of feeding a hog in each of the lots?

4. What was the average cost per 100 lb. of gain for each of these lots?

5. Estimate the probable cost of fattening a drove of 40 hogs from an average weight of 85 lb. to an average weight of 280 lb., if they are fed on the ration which was fed to lot 70.

6. How many bu. of corn will produce 100 lb. of pork if fed the ration fed to lot 66?

81. Feeding Hominy Feed and Corn Meal to Swine

In a third test carried on at the Purdue Experiment Station where hominy feed and corn meal were compared, the following results were obtained. This test began October 21 and lasted until February 18, 120 days. (Skinner and King, Indiana Experiment Station Bulletin 158.)

TABLE 50

	Lot 3 Hominy feed 2 parts Shorts 1 part	Lot 1 Corn meal 2 parts Shorts 1 part
Average weight at beginning (lb.)	99.1	99.3
Average weight at close (lb.)	176.0	157.9
Total feed consumed (lb.)	3587.0	3471.0

Lot 3 had 8 pigs 69 days, and 7 pigs 51 days.
Lot 1 had 8 pigs 95 days, and 7 pigs 25 days.
Hominy feed was priced at $25 per ton, shorts at $25 per ton, and corn meal at 59¢ per bushel.

1. What was the average amount of food eaten daily per pig?

2. What was the total gain per pig of each lot for the entire period?

3. What was the average daily gain per head in each lot?

4. What amount of each grain was eaten for every cwt. of gain by each lot?

5. What was the cost per average cwt. of gain in each lot?

6. If corn was worth 60¢ per bushel, shorts $30 per ton, and hominy feed $30 per ton, what was the average cost per cwt. of gain in each lot?

Optional Problems

During a 40-day test from January 6 to February 15, Skinner and King, of the Purdue Experiment Station, obtained the following results in comparing a corn-meal and tankage ration with a hominy feed and tankage ration.

TABLE 51

	Lot 19 5 pigs Hominy feed 20 parts Tankage 1 part	Lot 20 5 pigs Corn meal 20 parts Tankage 1 part
Average weight at beginning (lb.)	152.0	152.6
Average weight at close (lb.)	196.4	208.0
Total feed consumed (lb.)	1091.0	1171.0

These feeds were valued as follows: Hominy feed $25 per ton, corn meal 59¢ per bushel, and tankage $44 per ton. (Tankage is supplied by packing-houses.)

7. Find the average amount of feed eaten daily per head by each lot.

8. Find the total amount of each food fed to each lot.

9. Find the average daily gain per head for each lot.

10. What was the average amount of each ration eaten per pound of gain by each lot?

11. What was the average cost of each cwt. of gain for each lot?

82. Feeding Hogs off and on Pasture

An experiment was carried on at the Ohio Station to demonstrate the relative value of feeds for hogs off and on pasture. (Ohio Experiment Station Bulletin 242, East and Carmichael.)[1]

TABLE 52

Lot	Ration	Initial weight (lb.)	Final weight (lb.)
1	Corn and skim milk in dry lot	291.0	625.0
2	Corn and soy beans in dry lot	275.5	542.8
3	Corn in dry lot	282.3	447.8
4	Corn on mixed pasture	285.0	550.8
5	Corn on clover pasture	284.0	580.0

Lot 1: Corn 964 lb.; skim milk 2879.5 lb.
Lot 2: Corn 834.4 lb.; skim milk 208.6 lb.
Lot 3: Corn 887.3 lb.
Lot 4: Corn 1134 lb.
Lot 5: Corn 1148.3 lb.

1. What was the gain per pig in each lot?

2. What was the average daily gain per pig in each lot?

3. With ear corn worth 56¢ per bushel, skim milk 15¢ per cwt., soy beans $1.50 per cwt., and pasture 16.66¢ per pig for the entire period, what was the average cost per 100 lb. of gain on lots 3 and 5?

[1] Three pigs in each lot. The test lasted from June 24 to August 25 (62 days).

4. What was the average amount of pork produced by 1 bu. of ear corn in lot 3?

5. What was the average amount of pork produced by 1 bu. of ear corn in lot 5?

Optional Problems

6. What were the average amounts of dry matter, protein, carbohydrates, and fats in the ration fed to lot 3?

7. Determine the nutritive ratios of the feed fed to each group.

83. A Balanced Ration for Swine

(Wolff-Lehmann Standards, showing the amount of food required per 1000 lb. of live weight for both growing and fattening swine.)

TABLE 53

Age in months	Weight (lb.)	Digestible nutrients			
		Dry matter (lb.)	Protein (lb.)	Carbohydrates (lb.)	Fat (lb.)
Growing swine for breeding					
2–3	50	44	7.6	28.0	1.0
3–5	100	35	5.0	23.1	0.8
5–6	120	32	3.7	21.3	0.4
6–8	200	28	2.8	18.7	0.3
8–12	250	25	2.1	15.3	0.2
Growing swine for fattening					
2–3	50	44	7.6	28.0	1.0
3–5	100	35	5.0	23.1	0.8
5–6	150	33	4.3	22.3	0.6
6–8	200	30	3.6	20.5	0.4
8–12	300	26	3.0	18.3	0.3

1. Find the nutritive ratio of the food requirements for the swine of various ages grown for breeding.

2. Find the nutrition ratio of the food requirements for swine of various ages grown for fattening?

84. Weekly Gain of Suckling Pigs

Henry, of the Wisconsin Experiment Station, recorded the average gains of 12 litters of pigs, containing 84 pigs in all, for a period of 10 weeks from birth to weaning time. The results are recorded in the following table. (Henry's *Feeds and Feeding.*)

TABLE 54

Average weekly rate of gain for 10 weeks

Age	Average weight (lb.)
At birth	2.5
First week	4.4
Second week	7.0
Third week	9.8
Fourth week	12.5
Fifth week	15.6
Sixth week	18.6
Seventh week	22.6
Eighth week	27.8
Ninth week	33.1
Tenth week	38.5

1. What was the total gain of these pigs for each week of the test?

2. Compute the total weight of the 84 pigs at the end of each week.

3. What per cent of the final average weight was the average weight at birth?

4. A farmer owns 95 pigs 9 weeks old. If they have grown as rapidly as those reported in Table 54, what is their probable weight?

CHAPTER IX. SHEEP FEEDING

85. Silage for Ewes

At the Purdue Experiment Station, Skinner and Smith carried on some tests to determine the value of silage for ewes with fall lambs, with the following results. (Indiana Experiment Station Bulletin 147.)

TABLE 55

Lot	Average gain per ewe (lb.)	Average weight per fleece (lb.)	Average daily gain per lamb (lb.)
1. Silage and clover hay 2 year....	25.4	10.8	.464
2. Clover hay 2 year.............	16.0	10.0	.47

NOTE — One lot was fed clover hay alone as a roughage, while the other lot was fed both clover hay and silage as roughage.

1. What per cent of the average gain of the silage-fed ewes was the average gain of the ewes which were not fed silage?

2. Estimating the value of the ewes at $5 per cwt., and wool at 20¢ per pound, what was the average increase in the value of the ewes from feeding silage?

3. At the Purdue Station three lots of lambs fed on silage gained daily .43 lb., .42 lb., and .5 lb., respectively. What was the average daily gain per lamb for all of the lots?

4. The average weights of fleeces in each of the six lots of sheep at the Purdue Station were 9.9 lb., 10.35 lb., 11.7 lb., 9.7 lb., 10.8 lb., and 10 lb., respectively. What was the average weight of the fleeces in the six lots?

5. What was the average value of these fleeces at 22¢ per pound?

86. Rations for Fattening Lambs

At the Purdue Experiment Station, Skinner and King carried on a series of tests to determine the relative value of a combination of timo-

thy, clover, cotton-seed meal, and shelled corn, for fattening lambs. The foods were fed in the proportions tabulated below. (Indiana Experiment Station Bulletin 162.)

TABLE 56

	Lot 1 Shelled corn timothy hay	Lot 2 Shelled corn cotton-seed meal timothy hay	Lot 3 Shelled corn clover hay	Lot 4 Shelled corn cotton-seed meal clover hay
Initial cost per cwt	$6.80	$6.80	$6.80	$6.80
Initial wt. (lb.)	1110.0	1113.0	1120.0	1123.0
Final wt. (lb.)	1466.0	1642.0	1709.0	1740.0
Total feed (lb.) —				
Shelled corn	1815.0	1900.5	2140.0	1900.5
Oats	119.0	119.0	119.0	119.0
Cotton seed	..	264.0	..	264.0
Clover hay	..	..	2409.0	2502.5
Timothy hay	1463.0	1631.5	..	..
Corn silage	..	..	..	..
Actual value in lots without shrinkage	$5.15	$5.50	$5.55	$5.65

1. What was the initial cost of each lot?

2. With corn worth 40¢ per bushel, oats 32¢ per bushel, cotton-seed meal $30 per ton, timothy hay $12 per ton, clover hay $10 per ton, and corn silage $3 per ton, what was the total cost of the feed for each lot?

3. What was the total number of pounds gained by each lot for the whole period?

4. At the end of 30 days a lamb weighing 63 lb. died in lot 1. For the remaining 61 days of the period the estimate on this lot is based on 19 lambs. All other lots consisted of 20 lambs. Determine the average daily gain per lamb in each of these lots.

5. What was the average amount of shelled corn eaten daily per lamb in each lot?

6. Find the average cost per cwt. of gain for each lot.

7. What was the aggregate value of the lambs of each lot at the end of the feeding period?

8. What was the aggregate loss per lot?

9. What was the average loss per cwt. on each lot?

Optional Problems

10. Find the amounts of dry matter, protein, carbohydrates, and fat, respectively, fed to lot 1.

11. What was the nutritive ratio of the feed fed to lot 1?

87. Nutrients Required by Sheep

(Wolff-Lehmann Standards, showing the amount of food required per 1000 lb. live weight for both wool and mutton; also for growing, mature, and fattening sheep.)

TABLE 57

Age in months	Weight (lb.)	Digestible Nutrients			
		Dry matter (lb.)	Protein (lb.)	Carbohydrates (lb.)	Fat (lb.)
Growing sheep, of wool breeds					
4– 6	60	25	3.4	15.4	0.7
6– 8	75	25	2.8	13.8	0.6
8–11	80	23	2.1	11.5	0.5
11–15	90	22	1.8	11.2	0.4
15–20	100	22	1.5	10.8	0.3
Growing sheep, of mutton breeds					
4– 6	60	26	4.4	15.5	0.9
6– 8	80	26	3.5	15.0	0.7
8–11	100	26	3.0	14.3	0.5
11–15	120	24	2.2	12.6	0.5
15–20	150	23	2.0	12.0	0.4
Mature sheep					
Coarse wool	..	20	1.2	10.5	0.2
Fine wool	..	23	1.5	12.0	0.3
Breeding ewes with lambs	..	25	2.9	15.0	0.5
Fattening sheep					
First period	..	30	3.0	15.0	0.5
Second period	..	28	3.5	14.5	0.6

1. What was the nutritive ratio of the sheep of each breed which were 11 to 15 months old?

2. A herd of mutton lambs 8 mo. old, weighing 80 lb. each, are fed daily 49 lb. of bran, 36 lb. of linseed meal, and 143 lb. of turnips for each 100 head. Determine the amount of clover hay necessary per 100 head to balance the protein in the ration.

(See Tables 39 and 56.)

3. A herd of mutton lambs 8 mo. old, weighing 89 lb. each, was fed daily 67 lb. of shelled corn and 50 lb. of linseed meal per 100 head. How many pounds of clover hay per 100 head was necessary to balance the protein?

CHAPTER X. HORSE FEEDING

88. Rations for Working Horses

At the Illinois Experiment Station series of experiments were carried on to determine the relative value of rations for horses at work upon the Experiment Station farms. The horses were divided into two lots with one horse from each team in each lot. This division insured an equal amount of work and a fair test of the ration used. (Illinois Experiment Station Bulletin 150.)

The horses in lot 1 were fed daily an average ration consisting of 7.51 lb. of ear corn, 7.51 lb. of oats, .91 lb. of oil meal, .62 lb. of bran, and 15.85 lb. of timothy hay. Corn was estimated at 50¢ per bushel; oats at 40¢ per bushel; wheat bran at $20 per ton; oil meal at $32 per ton; clover hay at $10 per ton; timothy hay at $12 per ton, and alfalfa hay at $16 per ton.

1. What was the cost of feeding this ration to a team of horses for one year?

2. These horses averaged 8.1 hours of work per day, what was the average cost of feed per hour of work?

(Time should be estimated on 300 work-days per year.)

3. Considering each team worth $400 and estimating money worth 6% interest, how much should be received an hour for a team fed upon the above ration to make it self-supporting?

4. If a man employed at $40 per month drives one of the teams referred to above, how much should be received per day for man and team to make expenses?

5. Estimating that one day in every ten work-days is lost, what will the team and man need to earn each week-day to make expenses?

6. The ration given above was fed to horses averaging 1325 lb. each. Determine the average amount of grain consumed daily by each horse per 100 lb. of live weight.

7. Find the average amount of hay fed daily per 100 lb. of live weight.

8. Compute the approximate daily ration required of a team of horses weighing 1000 lb. each, while doing farm work.

9. Horses in lot 2 averaged practically the same weight as those in lot 1 and did the same amount of work. They were fed the following average daily ration: corn 7.25 lb., oats 7.25 lb., oil meal .79 lb., bran .62 lb., and clover hay 15.7 lb. Determine the average cost of feeding a team of horses in this lot for one year.

10. The horses in this lot averaged 8.1 hours of labor per day. What was the average cost of feed per hour of labor?

Optional Problems

11. What will it cost to supply this ration for one year to a 2000-lb. team under like conditions?

12. Estimating the value of the team of horses in lot 2 at $400 and considering money worth 6% interest, how much should be received per hour for a 10-hour day during the working period of 300 days to make the team self-supporting?

13. Which is the cheaper ration for horses as conditioned by the experiment?

(See problems 1 and 9.)

14. What was the average amount of grain fed daily to each horse in lot 2 for each 100 lbs. of live weight?

15. Find the average amount of hay fed daily to each horse in lot 2 for each 100 lb of live weight.

16. A contractor has 5 teams averaging 2500 lb. each; 4 teams averaging 3200 lb. each; and 3 teams averaging 2800 lb. each. How much grain is required to feed them on the ration fed to lot 2?

17. What will it cost daily to feed them on the grain ration fed to the horses in lot 2?

89. Winter Rations for Horses

At the Michigan Experiment Station, Norton carried on a series of feeding tests for horses during a 10-week period in the winter months. The feeds used cost per ton as follows. (Henry's *Feeds and Feeding.*)

TABLE 58

Corn stover	$4.00
Oat straw	5.00
Carrots	3.00
Timothy hay	12.00
Ear corn	20.00
Oats	31.00
Wheat bran	24.00
Dried beet pulp	18.00
Old-process linseed oilcake feed mixture	30.00
Dried beet pulp, Bran, Linseed oilcake	21.00

The horses in lot 1 lost 11 lb. and those in lot 2 gained 14 lb. Lot 1 was fed 20.4 lb. of timothy hay and 11 lb. of oats daily, and lot 2 was fed daily 4.2 lb. of timothy, 8.6 lb. of corn stover, 4.3 lb. of oat straw, 5.4 lb. of carrots, 3.1 lb. of oats, 4.2 lb. of ear corn, and 2.6 lb. of feed mixture.

1. What was the average amount of feed consumed per horse in each lot, for the 10 weeks?

2. What was the cost of an average daily ration for each lot?

3. Estimate the average cost of feeding a horse in each lot for an entire year at the rate of cost for the 10 weeks.

4. What will it cost a farmer to winter 20 head of horses for a period of 120 days on the ration fed to lot 1?

90. Feeding Corn and Oats to Horses

Carmichael, of the Ohio Experiment Station, carried on an experiment to determine the relative value of corn and oats in conjunction with a mixture of timothy and clover. The test extended over a period of 48 weeks.

Corn was valued at 40¢ per bushel, oats at 30¢ per bushel, and hay at $8 per ton.

A lot of three horses taken from as many teams consumed on an average 14.9 lb. of ear corn, and 16 lb. of mixed hay. The other lot of three horses taken from the same teams each consumed daily an average of 14.8 lb. of oats, and 17.3 lb. of mixed hay. The average weight of the horses fed corn was 1525 lb. and for those fed oats was 1425 lb.

1. How many bushels of grain were eaten by each group of horses during the 48 weeks of the test?

2. Estimate the amount of grain needed to feed an average team of each group for one year.

3. What per cent of the cost of the corn ration was the cost of the oats ration?

4. With hay quoted at $20 per ton and oats at 50¢ per bushel, what will it cost to feed a similar team of horses the oats ration, for one year?

5. With oats worth 45¢ per bushel, what should be the price of corn per bushel in order that the two rations cost the same?

6. On the basis of the local prices of corn and oats, estimate the cost of feeding a team of 1200-lb. horses on each of the rations for one year.

7. With oats at 50¢ per bushel, corn at 60¢ per bushel, and hay at $18 per ton, how much will each ration cost per 1200-lb. horse for one year?

91. Fattening Horses for Market

A series of experiments in fleshing horses for market was carried on at the Illinois Experiment Station for the purpose of comparing the feeding value of the following rations: corn, clover hay, bran, and oil meal; corn and oats, clover hay, bran, and oil meal; corn and oats, timothy hay, bran, and oil meal.

The horses were grouped as follows: 5 horses in lot 1, 4 horses in lot 2, and 4 horses in lot 3. The prevailing prices of feeds consumed were as

follows; ear corn 35¢ per bushel, oats 30¢ per bushel, bran $20 per ton, oil meal $27 per ton, clover hay $8 per ton, and timothy hay $9 per ton. (Illinois Experiment Station Bulletin 141, by Obrecht.)

1. The total feed per average horse in lot 1 from February 6 to May 1 was as follows: corn 1483.4 lb., bran 198.7 lb., oil meal 34.3 lb., and clover hay 1164.5 lb. How much did the cost of the feed average per horse?

2. What was the average daily cost of this feed per horse for the 84-day test?

3. The average daily gain per horse in lot 1 for the 84-day test was 2.29 lb. What was the average cost per pound of gain?

4. The total average amount of feed consumed per horse in lot 2 was as follows: corn 723.84 lb., oats 723.84 lb., bran 202.6 lb., oil meal 34.1 lb., and clover hay 1133.7 lb. How much did the feed cost per horse in lot 2?

5. What was the cost of the average daily ration per horse in lot 2?

6. The average daily gain for the horses in lot 2 was 2.98 lb. What was the average cost per pound of gain?

7. Lot 3 consumed the following average amount of feed per horse: corn 704 lb., oats 697.1 lb., bran 217.2 lb., oil meal 34 lb., and timothy hay 1234.1 lb. What was the average cost of the feed per horse for the 84 days?

8. What was the average daily cost per horse?

9. The average daily gain per horse in lot 3 was 1.88 lb. What was the average cost per pound of gain?

Optional Problems

10. The initial valuation of the horses in lot 1 averaged $188, and the average valuation at the end of the test was $239. How much did the increase in value exceed the cost of the feed?

11. The average increase in the weight of the horses in lot 1 for the whole period was 192 lb. What was the value of each pound of increase in weight?

12. How much did the value per pound of increase in weight exceed the cost of the feed per pound of gain?

13. The initial valuation of the horses in lot 2 averaged $180, and the valuation at the end of the feeding period was $228.75. How much did the increase in value exceed the cost of the feed?

14. The average increase in the weight of the horses of lot 2 for the whole period was 250 lb. What was the value of each pound of increase in weight?

15. How much did the value per pound of increase in weight exceed the cost of the feed per pound of gain?

16. The initial valuation of the horses in lot 3 was $168.75 per horse, and the valuation at the end of the feeding period was $215. How much did the increase in value of the whole lot exceed the cost of the feed fed to the lot?

17. The gross gain for lot 3 was 630 lb. What was the value of each pound of gain?

18. How much did the value per pound of increase in weight exceed the cost of the feed per pound of gain?

19. What would be the cost of increasing the weight of a horse from 1650 to 1900 lb. if fed the ration provided for lot 3?

20. Determine the cost of increasing the weight of a horse from 1650 to 1900 lb. if fed the ration provided for lot 2.

92. Experimental Feeding of Colts

On the next page is a record of three lots of colts fed on different rations during the winter and summer from weaning time until they were 3 years old. This work was carried on at the Nebraska Station. (Nebraska Experiment Station Bulletin 130, by Snyder.)

TABLE 59

(Colts fed from Jan. 1 to Jan. 14, three years later)

Lot No	1	2	3
Forage ration, winter	Alfalfa	Alfalfa	Prairie hay and cane hay
Pasture ration, summer	Alfalfa	Native grass	Native grass
No. of colts in lot	10	9	10
Av. 1st wt. Jan. 1 (lb.)	588.5	617.7	617.7
Av. last wt. Jan. 14 (lb.)	1268.4	1228.3	1157.5
Cost of feed —			
Grain	$8.41	$8.41	$12.28
Forage	31.80	31.80	20.93
Pasture	25.09	12.27	12.27
Av. price	57.00	53.70	52.00

All of the colts were fed grain during the first winter. Lot 3 was fed grain during the second winter also.

1. What was the average yearly gain per colt in lot 1?

2. What was the average cost per pound of gain for the colts in lot 1?

3. What was the average yearly gain per colt in lot 2?

4. What was the average cost per pound of gain for the colts in lot 2?

CHAPTER XI. POULTRY FEEDING

93. Rations for Laying Hens

The following table shows the results obtained at the Kansas Experiment Station by Oscar Erf, in a series of tests to determine the best ration for laying hens. The hens in all the pens were White Leghorns. (Bulletin 150 of the Kansas Experiment Station.)

TABLE 60

No. hens	Feed		Spring (3 mo.)	Summer (3 mo.)	Fall (3 mo.)	Winter (3 mo.)
22......	Beef scrap	No. eggs	1077	848	29	443
		Value of feed	$3.04	$3.66	$3.53	$2.60
20......	Casein and corn	No. eggs	934	549	104	431
		Feed	$3.55	$3.12	$3.90	$1.93
17......	Casein, corn-and-cob meal, wheat, corn	No. eggs	880	742	61	377
		Feed	$4.05	$3.82	$2.29	$2.10
10......	Wheat, corn	No. eggs	269	169	22	193
		Feed	$1.54	$0.91	$1.43	$1.40
10......	Millet, corn	No. eggs	273	210	10	153
		Feed	$2.17	$2.05	$1.52	$1.00
5.......	Beef scrap, Kafir	No. eggs	193	154	23	97
		Feed	$0.98	$0.71	$1.18	$0.63

1. Find the average yield of eggs per hen for each of the 6 pens for each season.

2. Compute the average cost of feed per hen for each of the 6 pens for each season.

3. Compute the average cost of feed per egg for each of the 6 pens for each season.

4. Estimating eggs at 25¢, 18¢, 40¢, and 45¢ per dozen for the 4 seasons, respectively, find the profit per average hen in each pen for each season.

5. On the basis of this comparison determine which ration is most profitable for each of the seasons.

94. Analysis of Eggs

The following table is a report of an analysis of the eggs of several well-known breeds of chickens, made by Willard and Shaw, of the Kansas Experiment Station. The average relative amount of each portion is shown in per cents.

Table 61

Wt. of egg in ounces	Per cent of white	Per cent of yolk	Per cent of shell	Per cent of protein	Per cent of fat	Per cent of water
American Reds — 1.895	56.809	33.377	9.57	12.546	10.97	66.584
Plymouth Rocks — 1.869	57.24	32.567	10.0	12.65	10.394	66.39
White Leghorns (single comb) — 1.834	50.54	32.67	10.47	12.98	10.524	65.73
White Leghorns — 1.969	57.944	32.155	9.758	13.108	10.411	66.55

1. Find the amount of protein in an average egg from each variety of fowl.

2. Find the amount of water in an average egg from each variety of fowl.

3. What per cent of the white is the yolk of the egg from each breed?

CHAPTER XII. HOUSEHOLD ECONOMY

95. Composition of Milk

Milk is the most universally used human food. It varies in composition and cleanliness. Milk from the Jersey is usually richer in butter-fat than the milk product of other breeds; however, the milk from individual cows of other breeds may contain a higher per cent of butter-fat than the milk of the Jersey.

TABLE 62

An analysis of average milk

	Per cent
Butter-fat	3.5
Casein and albumen (protein)	3.7
Milk sugar (lactose)	5.0
Ash or mineral matter	.70
Water	87.10

1. What per cent of average milk is solid matter? (All but the water.)

2. How many pounds of solid matter are there in 125 lb. of milk?

3. The table shows the average composition of milk. Most State laws require that milk sold to the public shall contain not less than 3% butter-fat and 8.5% of other solids. What is the minimum requirement of fat in 460 lb. of milk?

4. What is the largest per cent of water in milk permissible by law?

(See problem 3.)

5. One quart of milk weighs 2.18 lb. One measuring-cup used in cooking holds one half pint. What is the weight of a measuring cupful of milk?

6. Willard, of the Kansas Experiment Station, found that an average White Leghorn egg weighs 1.969 oz. What is the weight of a dozen average White Leghorn eggs?

7. White Leghorn eggs contain 13.108% protein. How many quarts of milk contain as much protein as a dozen eggs?

8. The same eggs contained 10.411% fat. How many quarts of average milk are required to contain as much fat as a dozen eggs?

Optional Problems

9. Based on the comparative amount of fat alone, what is the value of eggs per dozen when milk costs 10¢ per quart?

10. The edible portion of a beef rib roast contains 19.6% protein. How many quarts of milk are required to supply the amount of protein contained in one pound of edible beef roast?

11. When purchased with bone and other waste, a beef rib roast contains 15.2% protein. Based on the protein content, what is the value of this meat per pound, when eggs cost 20¢ per dozen?

12. Round steak as purchased contains 17.5% protein. Sirloin steak as purchased contains 16.5% protein. When round steak is valued at 20¢ per lb., what is the value of sirloin on the basis of its protein content?

13. Evaporated or condensed milk is milk from which a part of the water has been removed by evaporation. It should contain about 8.5% fat and about 25% total solids including fats. What portion of water must be evaporated from average milk to produce evaporated milk?

14. How many ounces of evaporated milk are required to supply the solids and fat contained in a quart of average milk?

96. Recipes

Recipe for Biscuits

The following recipe is sufficient for making biscuits for 60 men: —

10 lb. of flour.	2 oz. salt.
1.25 lb. of fat.	10 oz. of baking powder.
2 oz. sugar.	

1. If a woman makes biscuits for 27 threshing hands, how much flour, salt, sugar, fat, and baking powder should she use?

2. What is the value of the flour if a 49-lb. sack costs $1.85?

3. If the other materials cost as follows, sugar 5¢ per pound, lard 20¢ per pound, baking powder 25¢ per pound, and the salt 2¢ per pound, what did the materials cost for the biscuits provided in problem 1?

Recipe for Corn Bread

The following is a recipe for corn bread for 15 persons:

1.5 lb. of corn meal	2 oz. of fat
$\frac{3}{4}$ lb. of flour	2 oz. of baking powder
$\frac{3}{8}$ oz. of sugar	

4. A boarding-house served corn bread to 22 boarders. Based upon this recipe, what portion of the various materials was required?

5. If corn meal costs 2¢ per pound, flour $1.85 per sack of 49 lb., sugar 5¢ per pound, baking powder 25¢ per pound and lard 20¢ per pound, what is the cost of the corn bread served to 22 people?

6. Make a corn bread recipe for a family of six.

Recipe for Lemonade

The following is a recipe for lemonade for 20 persons:

3.75 gal. of water
2 lb. of sugar
30 lemons

7. When lemons cost 30¢ per dozen, and sugar costs 4¢ per pound, what is the cost of making lemonade for 30 persons? For 100 persons?

8. Make a lemonade recipe for a family of six.

Recipe for Cocoa

The following recipe is given for making cocoa:

$\frac{1}{4}$ cup of cocoa	1 cup of water
$\frac{1}{4}$ cup of sugar	3 cups of milk

9. Determine the amount of milk necessary to make cocoa for 30 persons, if the above recipe is sufficient for four persons.

97. Canning Fruit

1. In canning raspberries 2 cups of sugar are required for 2 qt. of raspberries. Determine the number of pounds of sugar needed to can 2 cr. of raspberries.

(1 pt. of sugar weighs 1 lb.; 24 qts. in one cr.; a measuring cup holds $\frac{1}{2}$ pint.)

2. Canned blackberries require the same proportion of sugar as do canned raspberries. If sugar costs $4.80 per cwt., blackberries $1.60 per crate, quart jars 60¢ per dozen, what will the canned fruit from 1 cr. of berries cost per quart?

(A crate of blackberries should can about 24 qt.)

3. Currants are canned in the proportion of 1 qt. of sugar to 3 qt. of currants. If currants sell for $2.15 per crate, what will it cost to can 3 cr. of currants with sugar at $4.80 per cwt.?

4. A housewife canned during one season 20 qt. of raspberries, 25 qt. of blackberries, and 16 qt. of currants. What did the sugar cost at the rate of $4.75 per cwt.?

5. 1.5 qt. of sugar is mixed with 6 qt. of gooseberries when canned. To this mixture 1 pt. of water is added. With sugar at 5¢ per pound, what will it cost to can a crate of gooseberries which cost 9¢ per quart?

6. The same proportion of sugar is used with canned cherries as with canned gooseberries, but one half as much water is used. Determine the cost of canning a bushel of cherries which cost $2.50, if sugar costs 5¢ per pound.

7. Grapes are canned by using 6 qt. of grapes, 1 qt. of sugar, and 1 gi. of water. What is the cost of the sugar used in canning 3 bu. of grapes when sugar costs $4.80 per cwt.?

8. Peaches are canned by using the materials in the following

proportions: 8 qt. of peaches, 1 qt. of sugar, and 3 qt. of water. What will the canned fruit cost per quart if the peaches cost $1.50 per bushel, the sugar $4.80 per cwt., and the quart jars 60¢ per dozen?

(Usually about 16 qt. are canned from 1 bu. of peaches.)

9. Canned apples are prepared by combining 6 qt. of apples, 1.5 qt. of sugar, and 2 qt. of water. Determine the cost of canning 2 bu. of apples which cost $1.50 per bushel, when sugar costs 4.5¢ per pound.

10. Plums are canned by using 8 qt. of plums, 2 qt. of sugar, and 1 pt. of water. How much sugar is required to can 2 cr. of plums?

11. A farmer's wife canned in one season 25 qt. of raspberries, 15 qt. of blackberries, 26 qt. of currants, 110 qt. of apples, and 16 qt. of gooseberries. How many pounds of sugar did she use during the season?

98. Preserving Fruits

1. Equal parts by measure of fruit and sugar are used in preserving strawberries, cherries, and currants. Determine the amount of sugar used in preserving 6 cr. of these fruits.

2. Plum preserves are made by using 4 qt. of plums, 2 qt. of sugar, and 1 pt. of water. Determine the amount of sugar required for preserving 1 bu. of plums.

3. Jellies are made by mixing equal parts of fruit juice and granulated sugar. Determine the value of the sugar that must be mixed with 65 pt. of fruit juice, if sugar costs $4.80 per cwt.

4. Grape juice is prepared by using $\frac{1}{2}$ cup of sugar with each quart of juice. Determine the cost of the sugar, at 5¢ per pound, used in making 40 pts. of grape juice.

5. Sugar advanced 3¢ per lb. How much did this rise in sugar add to the cost of 40 pt. of grape juice?

99. Food Values of Meats

TABLE 63

The following table shows the fuel value of the various cuts of meat. The data in this table are taken from Farmers' Bulletin 391.

Kind of meat	Per cent of water	Per cent of protein	Per cent of fat	Per cent of ash	Fuel value in calories per pound of meat
Beef —					
Brisket	54.6	15.8	28.5	0.9	1495
Chuck rib	66.8	19.0	13.4	1.0	920
Flank	59.3	19.6	21.1	.9	1255
Porterhouse	60.0	21.9	20.4	1.0	1270
Neck	66.3	20.7	12.7	1.0	920
Ribs	57.0	17.8	24.6	.9	1370
Round	67.8	20.9	10.6	1.1	835
Shank	70.3	21.4	8.1	.9	740
Side	62.2	18.8	18.8	.9	1145
Veal —					
Side with kidney, fat and tallow	71.3	20.2	8.1	1.0	715
Mutton —					
Side without tallow	53.6	16.2	29.8	.8	1560
Lamb —					
Side without tallow	58.2	17.6	23.1	1.1	1300
Pork —					
Tenderloin	66.5	18.9	13.0	1.0	900
Chops	50.7	16.4	32.0	.9	1655

1. On the basis of fuel value determine the value of porterhouse per pound when round steak cost 22¢ per pound.

2. On the basis of the protein content what is the value of porterhouse when round steak costs 22¢ per pound?

3. On the basis of protein content what is the value of neck when round steak costs 22¢ per pound?

4. On the basis of calories per pound what is the value of shank when round steak costs 22¢ per pound?

5. What per cent of the protein is the fat in round steak? In chuck rib?

100. The Quantity of Beef

An experiment was carried on at the Illinois Experiment Station, under the supervision of Mumford and Grindley, by Hall and Emmet, to determine the quantity of the finished beef product as delivered to the ultimate consumer, and to determine the relative value of these meat products. (Illinois Experiment Station Bulletin 158.)

TABLE 64

Results of slaughter tests

	Steer No. 1 (lb.)	Steer No. 2 (lb.)	Steer No. 3 (lb.)
Live weight	902.0	1190.0	1360.0
Dressed beef, warm	549.0	739.0	870.0
Dressed beef, cold	544.5	724.5	870.0
Right half of carcass	274.3	357.0	430.0
Left half of carcass	270.2	356.0	440.0

1. Find the per cent of cold dressed beef that was secured from steer No. 1.

2. Find the per cent of cold dressed beef that was secured from steer No. 2.

3. Find the per cent of cold dressed beef that was secured from steer No. 3.

101. Wholesale Cuts of Meat

TABLE 65

(From Illinois Experiment Station Bulletin 158)

	Steer No. 1 (lb.)	Steer No. 2 (lb.)	Steer No. 3 (lb.)
Loin	42.58	63.45	70.46
Rib	26.53	35.78	40.52
Round	60.15	77.12	92.11
Chuck	61.86	77.07	91.55
Plate	40.13	51.95	72.50
Flank	14.53	19.30	20.37
Fore shank	13.93	16.50	21.96
Kidney suet	10.65	17.03	15.06

(The above weights include one side of the carcass only.)

1. What per cent of the cold dressed beef of each steer was loin?

2. The cost per pound of the total amount of meat in cuts was: loin 25¢, rib 17.5¢, round 13.9¢, chuck 10.8¢, flank 8¢, fore shank 8.4¢. Determine the value of each wholesale cut for steer No. 1.

3. In a sirloin steak (hip bone) the bone averaged 16.05% of the weight of the entire cut. If a consumer purchased a 5.5-lb. cut of this sort of steak at 25¢ per pound, what was the value of the meat per pound?

4. The relative amount of bone in the retail cuts of porterhouse taken from these steers averaged 7.79%. On the basis of these results, what is the value of the meat in a pound of porterhouse steak which costs 25¢ per pound?

5. 54.26% of a 9th and 10th rib roast was lean, 31.41% was fat, and 13.97% was bone. Find how many pounds of each is obtainable from a 10-lb. roast.

102. Fuel Value of Boneless Meat

TABLE 66

(From Illinois Experiment Station Bulletin 158)

	Large calories furnished by 100 grams of boneless meat
Flank	554.9
Plate	483.1
Rib	419.7
Rump	405.8
Loin	396.8
Chuck	313.7
Neck	303.0
Hind shank	257.9
Fore shank	253.7
Round	350.5
Clod	235.1

NOTE — 453.49 grams equal 1 pound. A large calorie is the amount of heat required to raise 1 kilogram of water 1 degree centigrade.

1. Determine the relative heat-producing quality of these cuts in terms of per cent, using the highest as the base.

2. When flank steak costs 10¢ per pound and round steak costs 15¢ per pound, what is the relative cost per unit of heat produced?

103. Clothing

1. Muslin usually sold at 8¢ per yard was marked down to 5¢ per yard. What was the per cent of discount?

2. How much did a purchaser save on a 40-yd. purchase by waiting for the reduction?

3. Gingham marked at 10¢ per yard was sold at 20% below the marked price. What did this gingham sell for per yard?

4. Taffeta silk 1 yd. wide was sold at $1.50. At a special sale it was marked down 20%. For what did it sell?

5. How much was saved on a dress requiring 5¼ yd. of taffeta silk by waiting for the special sale?

6. Mrs. Wright purchased 15 yd. of crinkle crêpe for children's dresses, at 22¢ per yard. What did the material cost?

7. A few days later at a special sale the same quality of crinkle crêpe sold at 13¢ per yard. What was the per cent of discount?

8. How much would Mrs. Wright have saved on her purchase if she had waited for the special sale?

9. Find the cost of a silk poplin dress if the materials cost as follows: 6½ yd. of poplin at $1.25 per yard, 3 yd. of narrow velvet at 25¢ per yard, 1 yd of chiffon at $1 per yard, ½ yd. of all-over embroidery at $1.75 per yard, 1 doz. buttons at 60¢, 2 spools of silk thread at 10¢ each, 1 card of hooks and eyes at 10¢, and 2½ yd. of lining at 10½¢ per yard.

10. Find the cost of the materials for a house dress at the following prices: 7 yd. of gingham at 12½¢ per yard, 2½ yd. of embroidery at 25¢ per yard, 1½ doz. buttons at 30¢ per dozen, and 2 spools of thread at 5¢ each.

104. Household Furnishings

1. A Body Brussels rug 9 ft. by 12 ft., usually sold at $32, was marked down to $24, because the firm had discontinued making that pattern. What was the rate of discount?

2. Three Wilton rugs 9 ft. by 12 ft. were purchased at $42 each. If the purchaser received a discount of 5% for cash, what did each of the rugs cost him?

3. Three small Wilton and two small Body Brussels rugs were also purchased. If the Wilton rugs cost $7.50 each and the Body Brussels rugs cost $3.50 each, what was the cash discount on these rugs at 5%?

4. What will it cost to curtain 8 windows with scrim at 35¢ per yard, if 2¾ yd. are needed per single curtain, and two curtains are hung at each window?

105. Household Conveniences

Mrs. Eugene Davenport, of the University of Illinois, in a bulletin gives the following prices for household conveniences which make work in the farmhouse lighter:

Water system —	
Pumping outfit with 1.5 H.P. gasoline engine	$330.60
Installation of pumping outfit	60.00
Pressure tank for soft water 140 gal	32.40
Hydraulic lift	35.00
Range boiler	10.00
Household machinery —	
Shafting	$100.00
Washing machine	50.00
Mangle	150.00
Wringer	15.00
Laundry tubs	20.00
Vacuum cleaner	190.00
Installation of cleaner	15.00
Electric lighting —	
40 ampere 30 volt battery	$ 60.00
Dynamo	65.00
Switch board	60.00
Lamps	20.00
Installation	105.00

1. Determine the total cost of this water system.

2. With interest and upkeep on this water system at 12% per annum, what does it cost per year to supply the house with water?

3. Find the cost of the household machinery.

4. What does the lighting system cost?

5. What is the total cost of all these household conveniences?

6. If 52 washes occur each year and the interest and upkeep on the washing machine, mangle, and tub is 12% of its initial cost, what is the cost of the machinery per wash?

7. The interest and upkeep on all farm conveniences is 12%. What is the cost of the entire outfit per year?

CHAPTER XIII. RATIO AND PROPORTION

106. Form in Ratio and Proportion

Nothing is more natural than to predict what will happen from what has happened. From an observation of a known relation we are able to predict to a certainty an unknown relation. We observe that 300 qt. of berries are picked daily by 10 boys. On the basis of this observation we learn that 20 similar boys are needed to pick 600 qt. daily. The quotient of two numbers expressed as a division is a ratio. Consequently the *ratio* of $\frac{300 \text{ qt.}}{600 \text{ qt.}}$ is the indicated quotient $\frac{1}{2}$. Likewise the *ratio* of $\frac{10 \text{ boys}}{20 \text{ boys}}$ is $\frac{1}{2}$.

Since each of the ratios is $\frac{1}{2}$ it is evident that $\frac{300}{600} = \frac{10}{20}$. An equation of two ratios is known as a *proportion*. A proportion is usually expressed as follows:

$$300 : 600 :: 10 : 20$$

It is read: 300 is to 600 as 10 is to 20. By inspection we see that $20 = \frac{600 \times 10}{300}$. 20 is the quotient of the product of the *mean* terms divided by the given *extreme* term. Since the product of the mean terms of a proportion equals the product of its extreme terms and since the mean terms and the extreme terms are related respectively, it follows that: when three terms of a proportion are given the fourth may be found by dividing the product of the two *related terms* given by the third given term.

The character of the unknown term determines the order of the other terms in a proportion. The following problem requires a different statement from the one above though it involves the same numbers. If 10 boys pick 300 qt. of berries daily, how many quarts of berries can 20 such boys pick? The formal statement follows:

$$10 : 20 :: 300 : ?$$

$$\frac{20 \times 300}{10} = 600$$

107. The Algebraic Equation

By the use of the *Algebraic Equation* the unknown term is easily determined. By this method the *proportion* is kept in the form of an equation. For example the above problem may be solved as follows:

$$\frac{10}{20} = \frac{300}{x}$$

$10x = 6000$ (Obtained by multiplying both terms by $20x$)

$x = 600$ (Result of dividing both terms of the equation by 10)

1. If 200 lb. of silage are required daily by 5 milk cows, how much silage is required to feed 30 cows of similar weight and milk production?

Statement: $5 : 30 :: 200 : x$

First solution:

$$\frac{5}{30} = \frac{200}{x}$$

$5x = 6000$ (Obtained by multiplying both terms by $30x$)

$x = 1200$ (Obtained by dividing both terms by 5)

Second Solution:

$$\frac{30 \times 200}{5} = 1200 \therefore 1200 \text{ lb. of silage are needed}$$

2. If 100 apples trees cost \$12.50, how many such trees can be purchased for \$100?

Solution:

$$\frac{100}{12.50} = \frac{x}{100}$$

$\frac{10000}{12.50} = x$ (Obtained by multiplying both sides of the equation by 100)

$800 = x$ (Obtained by simplifying the left hand member of the equation)

3. An automobile party traveled 106 miles in 5 hours. At the same rate of travel, how long will it take the party to travel 306 miles?

4. Mr. Smith's taxes in a certain year upon a quarter section of land (160 acres) were $149.48. What were the taxes on an adjoining 50 acres, assessed at the same value as Mr. Smith's land and subject to the same tax levies?

5. A special assessment for improving a new road lying along the side of Mr. Smith's land is $74. What is the special road assessment upon an 84-acre tract similarly located as to the road and valued at the same price per acre?

6. If a county clerk drawing a salary of $1500 per year is assessed $30 by the party henchman for campaign purposes, how much should the county treasurer, who makes $2500 per year, be subject to assessment?

7. If 30 tile are required for a ditch 35 ft. long, how long a ditch will 890 such tile drain?

Optional Problems

8. Cement is mixed with gravel in the proportion of 1 part of cement to 6 parts of gravel. How many tons of gravel are required to secure the right proportion when mixed with 24 bbl. of cement?

(396 lb. of cement in one bl.)

9. Bordeaux mixture may be made by mixing 4 lb. of copper sulphate with 4 lb. of lime. How much lime is required to make 35 lb. of Bordeaux mixture?

10. Concrete may be made by mixing 1 part of cement, 2 parts of sand, and 4 parts of crushed stone. How many tons of crushed stone are necessary to form the proper mixture when added to 32 bbl. of cement?

(396 lb. of cement in one bl.)

11. How many barrels of cement are necessary to form a mixture when 6000 lb. of sand are used?

12. How much sand is necessary to properly combine with 24 tons of crushed stone?

13. Lime-sulphur spray may be made by mixing 20 lb. of lime, 15 lb. of sulphur, and 50 gal. of water. How much lime is required to mix with 35 lb. of sulphur to make lime-sulphur?

108. The Rectangular Method of Standardizing Milk

Dairymen generally employ the *Rectangular Method* of standardizing milk. The simplicity and correctness of this method of mixing cream and milk accounts for its popularity. After the per cent of butter-fat in both the cream and the milk to be mixed is determined and the per cent of butter-fat in the mixture to be formed is decided, the rectangle is drawn and the numbers which equal the per cent of butter-fat in the cream, in the milk, and in the mixture to be formed, are located as shown in Fig. 7.

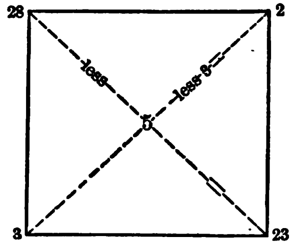


FIGURE 7

Given — 1. Cream containing 28% butter-fat.
2. Milk containing 3% butter-fat.

Required — 1. A mixture of the two which contains 5% butter-fat.

Process — $5 - 3 = 2$
$28 - 5 = 23$

Result — A mixture of 2 parts of the cream and 23 parts of the milk is required to provide a mixture containing 5% butter-fat.

Analysis of the Process —

$28\% - 5\% = 23\%$ (The per cent of butter-fat in a unit-quantity of cream in excess of the desired 5% mean)

$5\% - 3\% = 2\%$ (The per cent of butter-fat in a unit-quantity of milk short of the 5% mean)

If 1 unit-quantity of the *cream* has an excess of 23% butter-fat, $\frac{1}{23}$ part of a unit-quantity of cream has 1% excess of butter-fat over a unit-quantity of the mean.

If 1 unit-quantity of the *milk* has a deficit of 2% butter-fat, $\frac{1}{2}$ of a unit-quantity of milk is 1% short of the butter-fat of the mean.

It is evident that each time $\frac{1}{2}$ of a unit-quantity of *milk* is taken, $\frac{1}{23}$ of a unit-quantity of *cream* must be takėn to offset the deficit below the mean (5%) desired. This process is expressed in the following proportion:

$$\tfrac{1}{23} : \tfrac{1}{2} :: 2 : 23$$

1. By means of the rectangular method find how many parts of cream containing 25% butter-fat and how many parts of milk containing 3% butter-fat are needed to form a mixture containing 4% butter-fat.

2. A dairyman who is under contract to furnish milk containing 4% butter-fat finds that it tests but $3\frac{1}{2}$% butter-fat. How much cream containing 25% butter-fat will be needed in each gallon of this mixture to secure the required 4% butter-fat?

CHAPTER XIV. POWERS AND ROOTS OF NUMBERS

109. Powers of Numbers

When a number is repeated two or more times as a factor, the product thus secured is a *power of that number*.

When 2 is taken twice as a factor the second power of 2 is obtained. When it is taken three times as a factor the product is the third power of 2.

(Without pencil)

1. Determine the 4th, 6th, and 8th powers of 2.

2. 16 is what power of 2?

3. 27 is what power of 3?

4. What is the second power of all numbers from 2 to 24 inclusive?

(Drill upon the process of obtaining these powers until they are obtained readily.)

5. How many sq. ft. are there in the area of a square each of whose sides is one yd.?

6. What is the area of a tract of land 160 yd. square?

110. Indicated and Determined Powers

For convenience, powers of numbers are frequently indicated instead of determined.

$8^2 = 64$; $3^3 = 27$; 8^2 and 3^3 are indicated powers, while 64 and 27 are determined powers of these numbers, respectively.

A power of a number is indicated by a small figure at the right and slightly above the number which is repeated as factor to produce the power. This small figure is an *exponent*.

1. Indicate the 3d power of 27; the 4th power of 8; the 12th power of 1; the 7th power of 36.

2. Determine the 3d power of 6; the 4th power of 2; the 6th power of 2.

111. Roots of Numbers

A number repeated as a factor to produce a power is a *root of that power*. Thus 2 is a root of 4; 6 is a root of 36; 3 is a root of 27; 25 is a root of 625. The number of times a number is repeated as a factor to produce a power determines what root it is of that power. 2 is repeated twice as a factor to produce 4 as a product. Consequently 2 is *the square root of* 4. 3 is taken 3 times as a factor to produce 27, therefore, 3 is the cube root of 27.

112. Indicated and Determined Roots

Like the power of a number, the root may be indicated or it may be determined. $\sqrt{4}$ is an indicated square root of 4, while 2 is the determined square root of 4. Likewise $\sqrt[3]{27}$ is the indicated cube root of 27, while 3 is the determined cube root of 27.

The roots of some numbers may be found by factoring. The factors of 81 are $3 \times 3 \times 3 \times 3$. By grouping these factors into two groups we have (3×3) (3×3). $\therefore$ 9 is the square root of 81.

$$\begin{array}{r|l} 3 & 729 \\ \hline 3 & 243 \\ \hline 3 & 81 \\ \hline 3 & 27 \\ \hline 3 & 9 \\ \hline & 3 \end{array} \qquad \begin{array}{l} = (3 \times 3) \times (3 \times 3) \times (3 \times 3) \\ \quad (\ 9\ ) \times (\ 9\ ) \times (\ 9\ ) \end{array}$$

Therefore 9 is the cube root of 729.

1. Find the cube root of 216 by factoring and grouping the factors.

2. Find the square root of 1296 by factoring and grouping the factors.

3. Find the 5th root of 3125 by factoring and grouping the factors.

4. Find the square roots of the following numbers by factoring and grouping their factors:

(1)	100	(5)	324	(9)	3600
(2)	144	(6)	784	(10)	1764
(3)	400	(7)	900	(11)	441
(4)	625	(8)	2500	(12)	1024

113. Formal Method of Extracting Square Root

When it is difficult to find the square root of a number by factoring, the following method may be employed:

(1) Extract the square root of 169.

```
   1  3
   1, 69
   1
23   69
     69
```

(1) Counting from right to left, separate the number into periods of two digits each. (1, 69.)

(2) Find the largest square in the left-hand period. Write the square root of this square directly above the period. Subtract the square from the period in question and annex the next period to the remainder. (In this case there is no remainder. The next period is 69.)

Place twice the root found (2) to the left of the new dividend (69), and use it for a trial divisor of the figures in the new dividend excepting the one on the right (9). Annex to this trial divisor the number 3 which is found by dividing 6 (the trial dividend) by 2 (the trial divisor). Place the trial quotient (3) over the 2d period in the dividend. Multiply the trial divisor (23) by the trial quotient (3). If the product is larger than the last dividend use a smaller trial quotient. If there is a remainder after subtracting the product from the new dividend continue as before.

114. Practice in Extracting Square Root

Extract the square root of:

1.	324	5.	12321	9.	25600
2.	400	6.	1953.64	10.	2116
3.	2704	7.	.81	11.	3844
4.	2.56	8.	.0441	12.	17424

Optional Problems

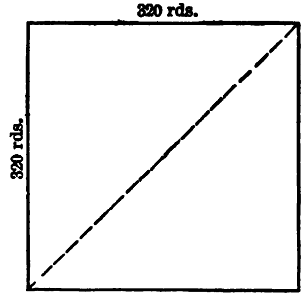


FIGURE 8

13. The number of units in the hypotenuse of a right triangle is equal to the number of units in the square root of the sum of the squares of the other two sides. Determine the length of the shortest distance from the northwest corner to the southeast corner of a section of land. (See section 117.)

14. A kite was sent up at a point 36 ft. from the base of a vertical tree. When it reached the top of the tree 100 ft. of the string had been unwound. How high was the tree? (The square of the units in the hypotenuse of a right triangle less the square of the units in one of the legs is equal to the square of the number of units in the other leg.)

15. How much will one save in distance in one year by cutting diagonally across a corner lot 60 ft. by 140 ft. instead of following the sidewalk, provided he makes two round trips to his home each day for a period of 300 days?

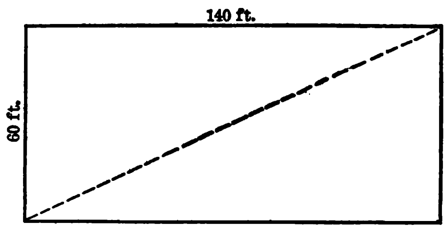


FIGURE 9

16. The base of a ladder 18 ft. in length is set on the ground at a point 6 ft. from the base of a tree and the top is placed against the tree. How far is the top of the ladder from the ground?

17. If the top of the ladder referred to in problem 16 were placed against the tree 6 ft. lower down, how far would the foot of the ladder be from the base of the tree? If the base of the ladder were 4 ft. from the tree, how high on the tree would the top of the ladder rest?

18. How long a rafter is required for the barn represented in the following figure provided the rafter extends 2 ft. beyond the plate?

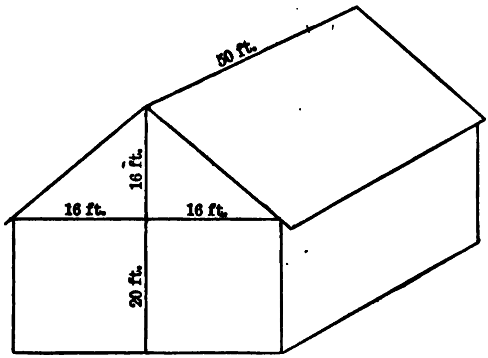


FIGURE 10

19. How long a wire "stay" is required to support a vertical telegraph pole 40 ft. high, if the wire is fastened to an iron rod in the level ground 20 ft. from the base of the pole and is attached to the pole 32 ft. from the ground?

CHAPTER XV. MEASUREMENTS

SURFACE MEASURE

115. Rectangular Areas

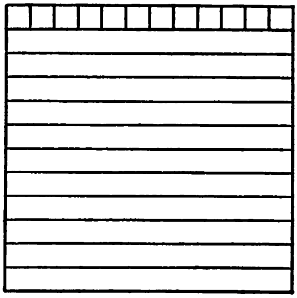


FIGURE 11

1. What will it cost to cement a cellar floor 16 ft. *square* at 10¢ per sq. ft.?[1] (Fig. 11.)

Right Angles

Two lines diverging from a point form an angle. The point is called the virtex and the lines are called the sides or legs of the angle. (Fig. 12.) If the lines diverge like those representing the sides of the cellar floor the angle is a *right angle.* When one straight line meets another as in Fig. 12 the angles formed are right angles.

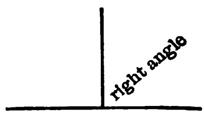


FIGURE 12

Rectangles

All quadrilaterals whose boundary lines form right angles are *rectangles.* A square is a rectangle whose sides are equal. (Fig. 11.)

2. How many square feet are there in a rug 9 ft. by 12 ft?

3. How many square rods are there in a rectangular strip of land 320 rd. long and 4 rd. wide?

4. How many square rods are there in a rectangular strip of land 160 rd. long and 1 rd. wide? How many square rods are there in one acre?

(See table for land measure.)

[1] The number of *square* feet in an area which has all *right angles* is found by taking the number of sq. ft. in one row as many times as there are rows. There are 16 sq. ft. of surface in one row along one side of the cellar and there are 16 foot-rows in the entire floor. 16 × 16 sq. ft. = 256 sq. ft.

5. How many acres are there in a rectangular strip of land 80 rd. long and 40 rd. wide?

6. How many square feet of concrete are required to pave a front walk which is 40 ft. long and 5 ft. wide?

116. Areas of Parallelograms not Rectangular

A *parallelogram* is a surface bounded by four straight lines the opposite pairs of which are equally distant at all corresponding points. (Figs. 13 and 14; the rectangle is a special form of the parallelogram.)

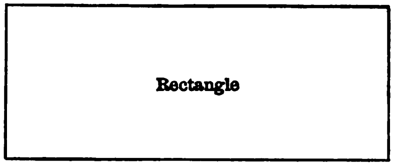


FIGURE 13

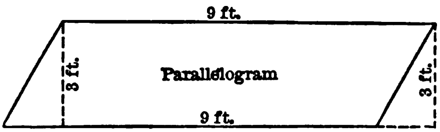


FIGURE 14

1. Find the number of square feet in the surface of the parallelogram represented by Fig. 14.

NOTE — Form a rule for finding the area of parallelograms not rectangular.

2. Find the area of a tract of land of the following dimensions: Its boundary extends from the northwest corner 30 chains east, thence southwest to a point 30 chains south of the north line; thence 30 chains west; thence northeast to the point of beginning.

117. Triangular Areas

Areas are often triangular in form, that is they are bounded by three straight lines. When one of the angles of a triangle is a *right angle*, the triangle is known as a *right triangle*. (See Fig. 15.) The side opposite the right angle is the hypotenuse of the triangle. The other sides are the legs of the triangle. The square of the number which represents the length of the hypotenuse equals the sum of the squares of the numbers which represent the lengths of the legs. ($H^2 = L^2 + L^2$.)

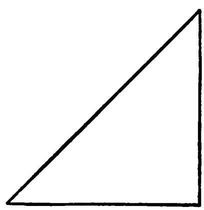


FIGURE 15

1. What part of a rectangle is a right triangle whose legs are sides of the rectangle?

2. Form a rule for finding the area of right triangles.

3. Find the number of sq. ft. of lumber required to side the end of the barn shown in (Fig. 10).

4. What is the length of the rafter if it extends six inches beyond the plate?

5. How many squares of paper roofing are required to roof this barn?

(A roll contains 1 square or 100 sq. ft.)

6. What will the roofing cost at $2.50 per roll?

7. What will it cost to roof this barn with corrugated iron worth $4.50 per square?

118. Circular Areas

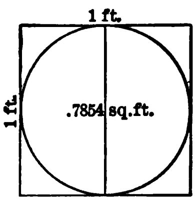


FIGURE 16

1. How many square feet are there in the circular floor of a milk house provided the floor is 8 ft. in diameter? (Fig. 16.)

NOTE — Fig. 16 shows that the area of a circle is less than the area of a square whose sides are the same length as the diameter of the circle. The area of a circle has been found to be approximately .7854 as large as the area of a square whose sides are equal in length to the diameter of the circle. (The area of a circle may be found by multiplying the square of the diameter by .7854, or approximately $\frac{11}{14}$.) Area of a circle equals $\frac{\pi D^2}{4} = \pi = 3.1416$.

2. How many square feet are there in the floor of a silo 16 ft. in diameter?

3. Find the cost of flooring a circular cistern 15 ft. in diameter with concrete at the rate of 15¢ per square foot. Determine the cost when concrete is worth 17¢ per square foot.

119. Lateral Areas

1. How much sheet iron is needed to make a cylindrical jacket for a stove if the jacket is 5 ft. in diameter and 6 ft. high?

(What is the shape of this piece of sheet iron, if it is laid flat upon the floor; see Fig. 17.)

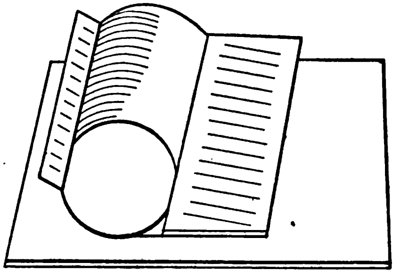


FIGURE 17

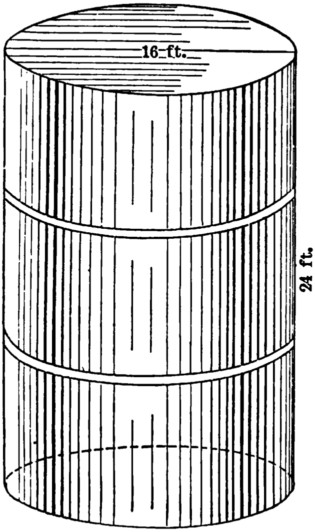


FIGURE 18

2. How much will it cost to put two coats of paint on the outer surface of a silo 24 ft. high and 16 ft. inside diameter at 18¢ per square yard?

(The walls of the silo are 6 in. thick.)

3. How many feet of lumber are required to board the walls of a silo if the dimensions are as given in problem 2?

(The amount of sawed timber in boards, beams, etc., is found by *board measure*. The unit is the *board foot*, i. e., the volume of a rectangular board one ft. long, one ft. wide, and one in. thick. When less than one in. thick, lumber is measured as if it were one in. thick. The number of board feet in a "squared" timber more than one in. thick is the product of its length in ft., its width in ft., and its thickness in inches.)

CUBIC MEASURE

120. Prisms

1. How many cubic feet of space are there in a box 5 ft. long, 5 ft. wide and 3 ft. deep? (Inside dimensions.) How many cubic feet

of space are contained in a bottom portion of the box 1 ft. deep? ($5 \times 5 \times 1$.) How many such portions are there in the box?

Form a rule for finding the solid contents of solids the shape of the cube shown in Fig. 19. Solids whose lateral faces are at right angles to their bases as shown in Fig. 19 are known as *right prisms*. When the surfaces of a right prism are all of equal size the prism is known as a *cube*. Form a rule for finding the solid contents of cubes and other right prisms.

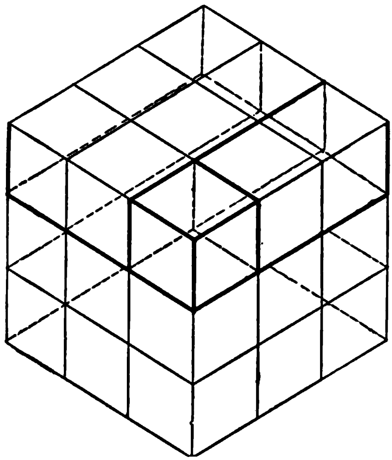


FIGURE 19

2. How many cubic feet of space are there in a crib the inside of which is 48 ft. by 14 ft. by 5 ft.?

3. How many bushels of ear corn will a crib of the above dimensions hold?

($2\frac{1}{4}$ cu. ft. in a bushel of ear corn.)

4. How many gallons of water will a trough of the right prism variety hold, if its dimensions are 12 ft., 3 ft. and 2 ft.?

Optional Problems

5. If the volume of water is increased approximately one ninth by freezing, how many quarts of water are contained in a piece of ice of the right prism type, the dimensions of which are 3 ft. by 2 ft. by 18 inches?

6. How many cubic feet of dirt are required to fill a porch box 10 ft. by 6 in. by 8 in.?

7. How many bushels of shelled corn can be put into a wagon bed 10 ft. by 3 ft. by 3 ft.?

(There are $\frac{4}{5}$ as many bushels as there are cu. ft.)

121. Cylinders

1. How many gallons of oil will a circular tank 24 ft. in diameter and 18 ft. high hold? A cubic foot is approximately $7\frac{1}{2}$ gallons.

NOTE — Solids of this type are known as *cylinders*. A cylinder of this type has a uniformly curved surface, and equal and parallel bases.

Form a rule for finding the solid contents of a cylinder. (See Fig. 20.)

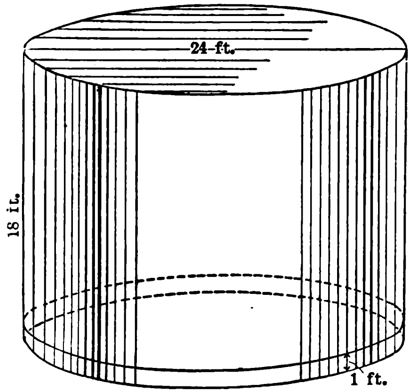


FIGURE 20

2. The Standard Oil Company has nine tanks in one of its sub-stations. Each tank is 20 ft. in diameter and 25 ft. high. How many gallons of oil will all of these tanks hold?

3. How much water will a circular tank hold, if it is 6 ft. long and 12 in. in diameter?

122. Spheres

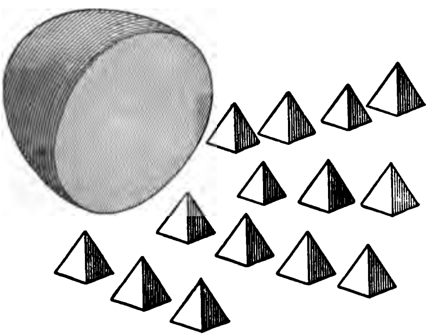


FIGURE 21

How many cubic inches of clay are contained in a spherical ball 5 in. in diameter?

Cut the clay ball into a number of parts as shown in Fig. 21. Each part is known as a *pyramid*. The contents of cones and pyramids are determined by multiplying the area of the base by one third of the altitude. Since the sphere is made up of a number of pyramids all of whose bases are the surface of the sphere and whose

altitudes are the *radii* (half the diameter) of the sphere, it is evident that the contents of a sphere may be secured by multiplying the number of units in the area of its surface by one third of the number of units in its radius. Solid contents $= \frac{R}{3} \times S$. The surface of a sphere is 4 times as great as the base of its hemisphere. (See Fig. 22.) The base of a hemisphere is a circle and its area is obtained by multiplying the square of its diameter by .7854 $(D^2 \times .7854) \therefore D^2 \times .7854 = D^2 \times \frac{\pi}{4}$.

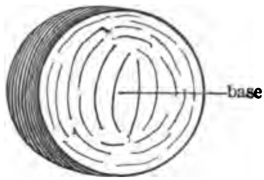


FIGURE 22

Since the area of the surface of a sphere is equal to an area four times the size of the base of its hemisphere it may be expressed as follows: $S = 4 \times D^2 \times \frac{\pi}{4}$ when S represents the surface of the sphere, D its diameter, R its radius and π represents 3.1416.

$\frac{R}{3} \times S =$ Solid contents of a sphere. Substituting the value of S as shown above, the solid contents of a sphere equals $\frac{R}{3} \times 4 \times D^2 \times \frac{\pi}{4}$. Since $\frac{R}{3} = \frac{2R}{6}$ then the solid contents of a sphere $= \frac{2R}{6} \times 4 \times D^2 \times \frac{\pi}{4}$, or $\frac{D}{6} \times 4 \times D^2 \times \frac{\pi}{4}$, or $\frac{\pi D^3}{6}$.

1. Find the number of cubic feet of gas contained in a balloon 25 ft. in diameter.

2. A boy inflates a small rubber balloon 6 in. in diameter in 4 blows. How many cubic inches of air are in the balloon? What is his approximate lung capacity?[1]

3. A 5-in. ball used in playing five pins, weighs 3.3 lb. How does the weight of this material compare with the weight of an equal volume of water?

(A cubic foot of water weighs approximately 62.45 lb.)

[1] No allowance should be made for the compression of the rubber.

CHAPTER XVI. FENCING

123. Fencing the I. S. N. U. Farm

The east and south sides of the "I. S. N. U. Farm" are fenced with the "American Steel Fence Posts" and a 47-in. all number 9 woven-wire, 6-in. stay, "Anthony Fence," protected on the top by a single strand of "American Special" barbed wire. "End posts" are used at the gates and "corner posts" at the southwest, southeast, and northeast corners, while all other posts are "line posts" set 12 ft. apart. The "end posts" and "corner posts" are 8 ft. long and are braced with gas piping 1.25 in. by 7 ft. The "line posts" are 6.5 ft. long. The gates are 12 ft. wide and are hung on the "end posts." There are two gates, one on each side of the farm fenced. The south side is 1660 feet and the east side 2220 feet. The length of the wire used in splicing is equivalent to the length of the gates.

1. Determine the number of line and end posts necessary to fence the east side of the I. S. N. U. Farm.

2. Determine the number of line, end, and corner posts necessary to fence both the east and south sides of the farm.

3. Determine the cost of the woven-wire fencing at 60¢ per rod for both the south and east sides.

4. What would the line posts cost for both the south and east sides at 30¢ each?

5. What would the barbed wire necessary to run one strand along the top of the south and east sides cost if an 80-rd. spool costs $2.40?

6. If end posts cost $2.50 each and corner posts $3.25, gates $7.50 each, what was the entire fencing bill for the south and east sides of the farm?

124. Fencing Section 15

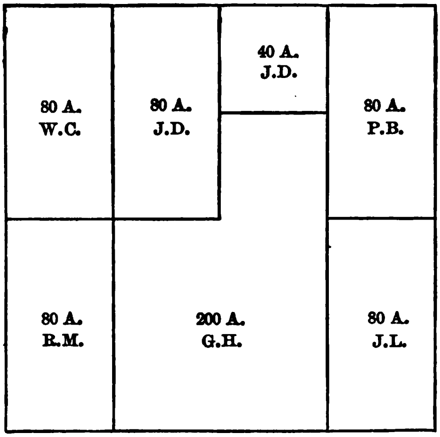


FIGURE 23

NOTE — There is a road 40 ft. wide on all sides of "Section 15." It must be remembered that the section lines extend to the corner stones which are in the center of the cross-roads. All estimates on farms lying along the roads should take this fact into account.

1. Determine the number of rods of fence required to enclose the farm belonging to J. D. in "Section 15."

2. Determine the amount of fence J. L. will need to build in order to enclose his farm.

(It should be remembered that he will need to build half of the line fences and all of the road fences.)

3. What will it cost J. L. to build his outside fences of the following materials: a number 9 woven-wire "Anthony Fence" 39 in. high with the stays 6 in. apart, supported with two strands of barbed wire; 6.5 ft. cedar posts set 1 rd. apart? A local dealer quoted the posts at 20¢ each, the woven wire at 52¢ per rod, and the barbed wire at $1.20 per spool of 40 rd. each?

4. Estimate the expense of building the fence referred to in problem 3, if the labor cost 12.5¢ per rod.

5. G. H. joins J. L. and P. B. in building a fence between their farms and his. What is the expense to each if they used the same kind of posts and wire that J. L. used to fence his eighty acres?

6. What will it cost G. H. to replace a hedge fence along the south side of his farm, with a number 9 woven-wire "Anthony

Fence" and steel posts, if it costs him 45¢ per rod to remove the hedge and if the wire and posts quoted by a local dealer are as follows: wire 62¢ per rod, corner posts at $3.35 each; end posts at $2.50 each; and the line posts at 40¢ each? The line posts are to be placed 12 ft. apart.

7. W. C. arranges with J. D. and R. M. to build the line fences on his 80 acres, with a 26-in. all number 9, 6-in. stay, "Anthony Fence," protected on the top with 3 strands of barbed wire and on the bottom by 1 strand of barbed wire. 6.5-ft. cedar posts are to be set 1 rd. apart. What will it cost W. C. for his outside fences if the woven wire is quoted at 42¢ per rod, the barbed wire at 3¢ per rod, and the posts at 20¢ each?

8. What does it cost J. D. and R. M., respectively, to join W. C.?

9. What will it cost R. M. to build the remainder of his outside fences if he builds his road fences like those of J. D., and if he joins G. H. with a fence like the one on the south side of G. H.'s 200 acres?

10. Had J. D. and R. M. used a 26-in. woven wire with a number 9 wire at the top and bottom only, all other parts of this fence being constructed of a number 12 wire, how much difference would there be in the initial cost of the fence joining W. C.?

(Local dealers quote the woven wire described above at 28¢.)

11. Determine the cost of fencing the entire roadside of "Section 15" with cedar posts set 12 ft. apart, and with 5 strands of barbed wire.

(Value cedar posts at 20¢ each and barbed wire at 3¢ per rod.)

CHAPTER XVII. BUILDING CONSTRUCTION

125. Dairy Barn Construction

Fig. 24 shows the method of framing a plank-frame barn. In a barn of this type there is not a piece of lumber used that is more than 2 in. thick and 12 in. wide. When a thicker piece of timber is desired, it is built up by spiking 2-in. planks together.

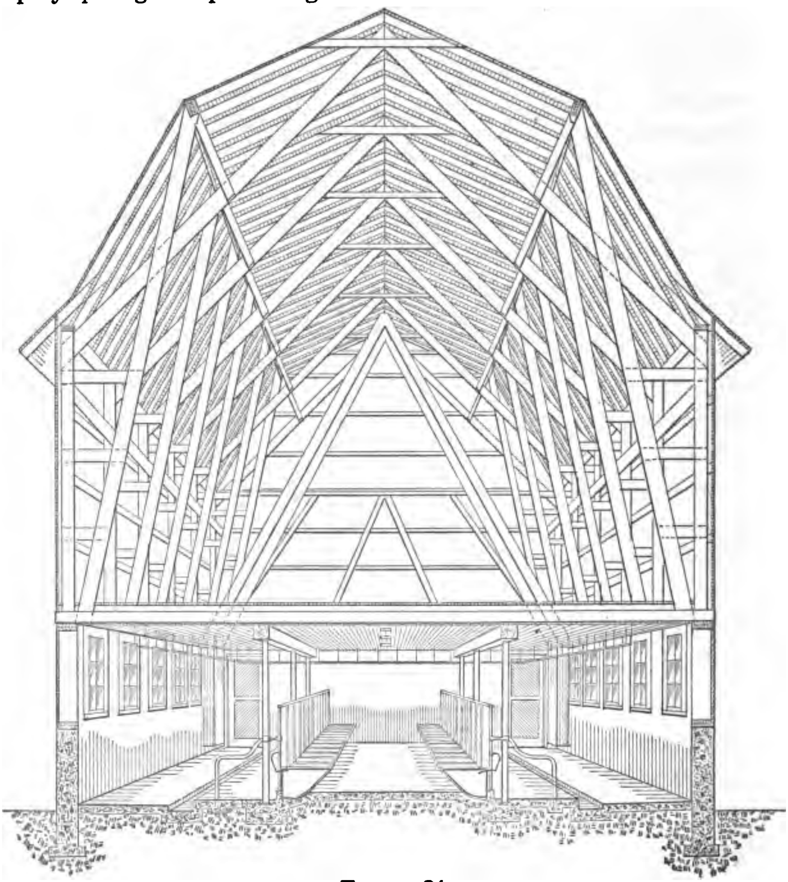


FIGURE 24

1. The barn shown in Fig. 24 is 36 by 50 ft. Determine the number of square feet of surface covered by the barn.

2. The outside walls are 12 in. thick. Find the square feet of surface covered by the floor of the barn.

3. It is 9 ft. from the floor to the ceiling. How many cubic feet of space are there in the first story?

4. There are 2 lines of cow stalls extending through the barn. There are 12 stalls in each line, and each stall is 3 ft. 3 in. wide. How much space is left for passageways at the ends?

5. A contractor charged 14¢ per square foot for constructing the barn floor. Find the cost of the floor.

6. A company which supplies barn equipment furnished the iron work for the stalls for $240. What was the average cost per stall?

7. The concrete wall for the barn was constructed upon a slab or base of concrete 6 in. thick and 2 ft. wide. Find the amount needed to construct this base of the main foundation.

8. On the top of this base a concrete wall 12 in. thick and 7 ft. high was constructed. Determine the amount of concrete in this wall.

(There are two 8-ft. and two 4-ft. doors in the barn. These door spaces extend 4 ft. below the top of the concrete wall.)

TABLE 67

(Showing the quantity of materials and the resulting amount of concrete for a two-bag batch of mixture.)

Kind of concrete mixture	Proportion by parts			Two-bag batch materials				
	Cement	Sand	Stone or gravel	Cement bags*	Sand (cu. ft.)	Stone or gravel (cu. ft.)	Water in gal. medium wet	Concrete (cu. ft.)
1:2:4...	1	2	4	2	3.75	7.5	8.5	8.5
1:2.5:5..	1	2.5	5	2	4.75	9.5	12.5	10.0

* One bag of cement is approximately 1 cu. ft. 396 lb. of cement equals 1 bl. or 4 bags.

TABLE 68

(Showing the quantities of materials, and the resulting amount of concrete for a two-bag batch where a natural mixture of bank sand and gravel is used.)

Kind of concrete mixture	Proportion by parts		Two-bag batch materials		
	Cement	Sand and gravel	Cement bags	Sand and gravel (cu. ft.)	Concrete (cu. ft.)
1:2:4..........	1	4	2	7.5	8.5
1:2.5:5.........	1	5	2	9.5	10.0

9. Table 67 shows the amounts of stone, sand, and cement used in constructing the concrete walls. Determine the amount of stone necessary to construct the foundation walls of the barn shown in Fig. 24 if a 1:2:4 mixture is used.

10. Determine the number of barrels of cement necessary to construct the walls of the barn.

11. Find the amount of sand necessary to construct these walls.

12. If the foundation walls were built by a contractor at 30¢ per cubic foot and no allowance was made for doors, what did they cost?

13. Find the amount of gravel necessary to build these walls if cement and gravel are used.

14. There are 2 sills 10 in. wide and 10 in. thick, running the entire length of the barn as a support to the joists. How many feet of lumber are there in these sills?

15. The joists are supported by the sills and in turn support the second floor. It is 12 in. from the center of one joist to the center of the next. How many joists are there in the building?

16. The joists are 2 in. thick and 12 in. wide. How many feet of lumber are there in the joists?

17. It is 21 ft. from the lower edge of the sills to the top of the plate at the eaves. How many feet of siding are needed to cover both sides of the barn?

(Take out 375 sq. ft. for windows.)

Optional Problems

18. How many feet of siding are needed to cover the ends of the barn as high as the eaves?

(Take out 120 sq. ft. for doors.)

19. That portion of the rafters extending from the plate at the eaves to the purlin plate is 14 ft. long. Determine the number of feet of lumber in this portion of the rafters, provided the rafters are 2 in. by 6 in. and placed 2 ft. apart on center and that the roof extends 2 ft. beyond the gables.

20. The "look-outs" spiked to the rafters at the eaves are 6 ft. long, and are spiked to the rafters so 3 ft. extend beyond the plate. Determine the number of feet of lumber in these "look-outs."

21. Find the number of square feet of surface in the entire roof if it extends 2 ft. beyond either end of the barn. It is 14 ft. from the purline plate to the ridge.

22. If the shingles are 4 in. wide, and are laid 4 in. to the weather, how many are necessary to cover 100 sq. ft.?

23. The first row of shingles at the eaves is usually doubled. Determine the number of shingles necessary to cover the entire roof of this barn.

24. The gable of the barn above the eaves is 60% of the gable from the bottom of the studding to the eaves. How many feet of lumber is necessary to side the ends of the barn?

(See problem 17.)

126. Painting

1. The shingles on the barn were dipped at a cost of $2 per thousand. Determine the total cost of dipping the shingles.

2. Determine the cost of painting the entire outside of the building two coats at 30¢ per square yard.

3. Find the cost of painting the ceiling of the first story at 30¢ per square yard.

4. What was the entire painting bill for the barn including the dipping of the shingles?

127. Concrete Floors

1. Concrete floors and sidewalks are usually made 4 in. thick. 3.5 in. at the bottom is similar to that in concrete walls. Determine the number of cubic feet of this sort of concrete in a sidewalk 3 ft. wide and 188 ft. long.

2. The surface of the walk is made by mixing 2 parts sand and 1 part cement. Determine the number of cubic feet of this material needed to finish the above walk.

3. Concrete silo walls are made of reinforced concrete 6 in. thick. Determine the amount of concrete in the wall of a silo 36 ft. high and 14 ft. inside diameter.

4. Find the amount of concrete in the wall of a silo 50 ft. high and 18 ft. inside diameter.

5. How many square feet are in the concrete floor of the silo provided in problem 4?

6. The foundation wall of this silo is 3 ft. deep and 18 in. thick. How many cubic feet of concrete are in the foundation if its inside dimension is 17 ft.?

7. The farmer building the silo provided in problem 4 hauled sufficient gravel to complete the structure. The floor was constructed as provided in problem 1. How many cubic yards of gravel were needed if a 1:2:4 mixture was used?

8. How many barrels of cement were necessary to build the silo described in problem 4?

9. How much each of crushed stone and sand is necessary to build tbis silo?

10. Determine the cost of building 890 ft. of 4 ft. sidewalk at 12.5¢ per square foot.

128. Ventilation

TABLE 69

(Showing number of cubic feet of air required per animal per hour to insure a supply of fresh air at all times.)

Animal	Cu. ft. per hr. per head	Assumed weight of animal (lb.)
Horses	4924	1200
Cows	3953	1100
Swine	1510	160
Sheep	929	100
Hens	37	3

1. Determine the number of cubic feet of fresh air needed per hour for 24 cows.

2. The average speed of air through a ventilating flue is 250 ft. per minute. If the inside dimensions of a flue are 6 in. square, how many cubic feet of air will pass through it in one hour?

3. How many flues of this size are required to ventilate a barn containing 24 cows?

4. How large a cross section of an out-take flue is required to carry out the air supplied by the in-take flues provided in problem 3?

5. If 4 out-take flues are constructed, what should be the cross-section of the inside of each to insure the removal of the air admitted by the in-take provided in problem 3?

6. A register with a face area of 6 in. by 8 in. has a capacity equal to 32 sq. in. of open flue. Determine the area of the faces of the registers needed on the in-take flues of the barn.

7. Determine the area of the faces required of the out-take registers in the barn if 4 of them are used.

8. In lighting a barn 4 sq. ft. of glass should be provided for each animal in the barn. How many 12-in. by 14-in. window glasses should this barn contain?

129. Plastering

1. Estimating plaster at $\frac{1}{2}$ in. thick, how many cubic feet of prepared plaster will it take to plaster a room 12 ft. by 18 ft. by 9 ft., if one tenth of the entire wall space is used for windows and doors?

2. Prepared plaster is sold in 100-lb. sacks for about 50¢ per sack. One sack of plaster is equivalent to 1 cu. ft. Determine the cost of the plaster for this room.

3. If a plasterer furnished the material and plastered the room provided in problem 1 for 30¢ per yard, without counting the openings for windows and doors, what will be the cost of plastering?

4. Determine the cost of plastering a room 12.5 ft. by 17 ft. by 10 ft. at 30¢ per square yard.

130. Papering

NOTE — In estimating wall-paper, contractors find the number of square feet in the ceiling and in the walls above the base-board. They determine the number of rolls required to cover this space. From this number of rolls they subtract a number of rolls equal to the number of doors and windows less one. A single roll of paper is 8 yd. long and 18 in. wide. A double roll is the same width, and twice as long. Prices on wall-paper are always for single rolls unless otherwise stated. Consider baseboards one foot wide.

1. Determine the number of rolls of paper needed to paper a kitchen 12 ft. wide, 15 ft. long, and 9 ft. high, if there are 3 windows and 2 doors.

2. How many rolls of paper are needed to paper a living-room 18 ft. by 24 ft. by 10 ft., if there are 6 windows and 4 doors in the room?

3. What will the paper for the above rooms cost at 18¢ per roll for the kitchen paper and 60¢ per roll for the living-room paper?

4. Find the cost of papering a bedroom 12 ft. by 15 ft. by 9 ft., provided the ceiling paper costs 42¢ per roll and the wall-paper costs 55¢ per roll, if there are 3 windows and 2 doors.

CHAPTER XVIII. SILOS

131. Dimensions and Capacities of Silos

TABLE 70

Inside diameter in feet	Height in feet	Capacity in tons	Inside diameter in feet	Height in feet	Capacity in tons
10	24	37	18	42	237
10	26	40	18	44	248
10	28	44	18	46	259
10	30	47	18	48	270
10	32	50	18	50	280
10	34	55	20	30	188
10	36	59	20	32	295
10	38	63	20	34	218
10	40	68	20	36	235
12	24	54	20	38	254
12	26	58	20	40	273
12	28	63	20	42	293
12	30	68	20	44	309
12	32	73	20	46	320
12	34	78	20	48	334
12	36	85	20	50	348
12	38	91	22	32	243
12	40	98	22	34	263
14	24	73	22	36	285
14	26	80	22	38	307
14	28	86	22	40	330
14	30	92	22	42	354
14	32	96	22	44	371
14	34	107	22	46	388
14	36	115	22	48	495
14	38	124	22	30	422
14	40	134	24	32	200
14	42	143	24	36	339
14	44	150	24	40	393
16	24	96	24	44	417
16	26	104	24	48	482
16	28	112	24	50	502
16	30	120	27	36	427
16	32	128	27	40	497
16	34	139	27	44	559
16	36	150	27	48	610
16	38	162	27	50	635
16	40	175	30	32	452
16	42	187	30	36	530
16	44	196	30	40	614
16	46	205	30	44	690
16	48	214	30	48	753
16	50	223	30	50	784
18	30	152	36	36	762
18	32	162	36	40	884
18	34	176	36	44	994
18	36	190	36	48	1085
18	38	205	36	50	1130
18	40	221	36	50	

Results obtained by the Illinois Experiment Station on the filling of silos. The labor of the men was charged at $1.25 and that of the teams at $1 each per day of 10 hours. A uniform charge of $2 per day was made for the wear on the silage cutter and for the money invested in it. The engine with engineer was charged at $5 per day; fuel at $3 per ton for coal and 15¢ per gallon for gasoline; twine at 11¢ per pound. These prices were the prevailing ones, when data were gathered. (Illinois Experiment Station Bulletin 101, by Fraser.)

TABLE 71

Data on silo filling

Farm number	1	2	3	4	5	6	7	8
Diameter of silo (ft.)	18.25	18.	22.	18.	19.	18.8	20.	20.
Depth of silage in ft. after settling 48 hr	21.0	23.5	24.0	27.0	33.0	29.5	22.0	38.
Tons silage estimated from dimensions	162.7	106.4	163.7	129.8	193.1	161.5	119.6	785.7
Acres cut	27.3	15.5	25.0	15.4	20.0	24.25	16.0	67.7
Distance hauled (rds.)	100.0	110.0	160.0	60.0	160.0	80.0	20.0	100.0
Teams hauling	6.0	5.5	6.5	4.0	3.5	2.5	4.0	7.0
Days labor (teams 10 hr.)	24.5	13.6	24.9	12.0	20.25	16.65	9.3	70.4
Days labor (men 10 hr.)	36.3	17.7	36.4	19.3	33.3	25.9	16.5	145.25
Engine hire	$16.50	$10.50	$16.00	$11.0	$23.75	$20.0	$7.5	$39.0
Use of cutter	6.60	4.20	6.40	4.40	9.50	8.0	3.0	15.60
Cost of fuel	6.30	3.75	6.00	2.25	6.75	7.05	4.0	16.40
Cost of twine	6.87	7.15	12.00	5.72	7.15	6.87	6.0	34.75

1. Find the average tonnage of silage per acre for the 8 farms.

2. What was the cost of team labor employed in filling silo on farm number 5?

3. What was the average cost of team labor per ton of silage for all of the silos?

4. What was the average cost of man labor for each ton of silage for all of the silos?

5. What was the average cost of engine hire per ton of silage for all of the silos?

6. What was the average cost of cutter hire for each ton of silage for all of the different silos?

7. What was the average cost of the twine per ton of silage for all of the silos? Of the fuel for all of the silos?

8. Compute the average cost per ton of silage for all of the silos.

Optional Problems

9. If the farms were rented for $7 per acre, what was the cost of the silage per ton, provided $7 per acre was expended in preparing the crop?

10. If the average dairy cow eats 35 lb. of silage per day, what will it cost to feed a dairy cow 200 days?

(Use average cost determined in problem 9.)

11. How large a herd can be fed from each of these silos for a period of 200 days, if each of the cows uses on an average of 35 lb. of silage per day?

132. Rate of feeding from Silos

TABLE 72

Rate of feeding from silos of different diameters

Diameter (ft.)	Approximate minimum pounds to be fed daily to keep from spoiling		Amount of silage consumed daily by the various animals					
	Summer	Winter	Horses	500 lb. calves	Stock cattle	Beef cattle	Dairy cattle	Sheep
10	725	263	10 lb.	12 lb.	20 lb.	25 lb.	40 lb.	3 lb.
12	755	378						
14	1030	515						
16	1340	780						
18	1700	850						
20	2100	1050						

If a silo is used for winter feeding, only half as many head of stock are required to keep the silage in good condition as are required in summer.

1. From Table 72 determine the number of animals of each kind that is required to be fed in winter to keep the silage from spoiling in a 20-ft. silo.

2. If a silo full of silage is 24 ft. high and 10 ft. in diameter, how long can 22 horses on a full ration be fed from it?

3. How long can 34 dairy cows be fed from a silo like the one referred to in problem 2?

4. A farmer has a silo 18 ft. by 50 ft. If he feeds 100 horses, how many stock cattle should be fed in summer to prevent the silage from spoiling?

5. How long will the silage last the stock provided in problem 4?

6. A farmer has a silo 20 ft. by 50 ft., and wishes to keep half stock cattle and half beef cattle. What is the minimum number of each he should keep during the winter? How long will the silage last this many cattle?

7. How many silos 20 ft. by 40 ft. will this farmer need to feed his cattle the entire year?

8. How long can 5 carloads of sheep of 140 each be fed from a silo 20 ft. by 50 ft.

9. A farmer feeds 10 horses and 30 dairy cattle. How many sheep should be fed during the summer months to keep the silage, in a silo 18 ft. by 56 ft., from spoiling?

10. A cattle feeder is feeding 150 steers during the winter months. He plans to feed these steers for 160 days. How many silos 16 ft. by 36 ft. should he have to supply a sufficient amount of silage?

11. If he should feed 150 steers and 60 stock cattle, how many silos of the above dimensions should he have?

12. How many calves can be fed for 180 days from a silo 20 ft. by 50 ft.?

13. W. A. Stacey, Davenport, Nebraska, built a concrete silo 14 ft. by 38 ft. for $558.50. What was the cost of this silo per ton of silage housed?

14. What number of dairy cattle can Mr. Stacey feed for 200 days?

15. If he feeds 8 horses and 30 sheep, how many dairy cattle could he feed?

16. Bert Mapes, of Norfolk, Nebraska, built a concrete silo at a total cost of $579.24. The silo was 16 ft. by 34 ft. What was the initial cost per ton of its housing capacity?

17. How many sheep will this silo feed for 200 days?

18. How many sheep should Mr. Mapes feed during the summer months to keep this silage from spoiling?

19. If Mr. Mapes feeds 10 head of horses, and 5 head of dairy cattle, and 4 calves, how many sheep should he feed during the summer to keep the silage in good condition?

20. A farmer has a silo 20 ft. by 50 ft. He feeds 10 horses, 50 dairy cattle, and 20 calves. How many days will this silage feed his stock?

Optional Problems

21. Estimate the tonnage of silage required to feed the herd of 20 cows kept on the "I. S. N. U. Farm" from December 1 to April 1 inclusive.

(The average milk cow requires about 40 lb. of silage per day.)

22. Estimate the tonnage of silage required to feed the same herd for an entire year.

23. Estimate the acreage of corn necessary to feed this herd as provided in problem 21.

(An acre of good corn makes approximately 12 tons of silage.)

24. What should be the diameter of a silo of the proper size to feed the herd of 20 cows on the "I. S. N. U. Farm" from November 1 to May 15?

25. How deep should this silo be to feed the herd properly for 250 days?

26. What acreage of corn is required to fill this silo?

(See problem 23.)

27. What is the largest diameter of a silo that may be properly used to feed this herd from May 16 to November 1?

28. What should be the inside depth of this silo to feed the same herd from May 16 to November 1 inclusive?

29. On the condition that this herd consists of 20 milk cows and 15 stock cattle, what should be the diameter of this silo for winter service?

30. If this herd in the summer consists of 20 milk cows and 10 stock cattle, what must be the diameter of the silo to insure economical feeding?

31. Give the dimensions of a silo suitable for a herd of 15 milk cows and 10 stock cattle, if they are put on a diet of silage October 1 and fed until May 15.

32. A farmer has a silo with an inside diameter of 20 ft. and an inside depth of 40 ft. How many milk cows should he keep in the winter months to feed this silage most advantageously?

33. If the herd referred to in problem 32 should be one third stock cattle, how large should the silo be to properly feed the herd during the winter months?

34. Determine the inside diameter of a silo required to feed most advantageously a herd of 20 milk cows and 20 brood sows, from November 1 to May 15.

(Brood sows require approximately four pounds of silage daily.)

CHAPTER XIX. HORTICULTURE

133. Spraying of Orchards

TABLE 73

The Nebraska Experiment Station makes the following summary of work done in the spraying of orchards: Average for four years. (Nebraska Experiment Station Bulletin.)

Number of orchards sprayed, 16
Total number of trees sprayed, 3300
Average age of trees, 18 years
Average number of sprayings per year, 4
Average quantity of spray per tree each year, 13 gallons
Average number of trees per acre, 50
Average cost of spray materials per 100 gal., $0.97
Average cost of applying spray per 100 gal., $0.98

Results of spraying

	4-yr. yield per tree
Sprayed trees	
Marketable fruit	44 bu. at 52¢ per bushel
Culls and windfalls	1.1 bu. at 6¢ per bushel
Unsprayed trees	
Marketable fruit	1.8 bu. at 41¢ per bushel
Culls and windfalls	1.7 bu. at 5¢ per bushel

1. What was the total cost of applying 100 gal. of the spray mixture?

2. What was the average annual cost of the mixture per tree?

3. What was the average annual cost per tree of applying the mixture?

4. What was the total annual cost of spraying each tree?

5. Approximate the annual cost of spraying an orchard of 25 acres?

6. What was the annual income from the fruit of the sprayed trees?

7. What was the income from an acre of sprayed trees?

8. From an acre of unsprayed trees?

9. What was the gross and net gain per acre gained by spraying trees?

10. How many gallons of spray mixture were required to spray an acre of trees when three applications were given?

11. The Nebraska Station recommends Bordeaux for the first spraying of apple trees, just as the clusters of buds open. This mixture consists of 3 lb. of freshly slaked lime, 3 lb. of copper sulphate, and 50 gal. of water. How many pounds of copper sulphate are needed to make one application to an orchard of 50 trees?

12. If a farmer has an orchard of 15 trees, how many pounds of lime and copper sulphate should be used in the spray for the first application?

13. The second spraying should be made just after the petals have fallen, but before the calyx cups have closed. This application should consist of Bordeaux mixture as in the first spraying, combined with $\frac{1}{4}$ lb. of Paris green. Determine the amount of material needed for this second spraying of the orchard provided in problem 12.

14. The material for the third spraying should be the same as that used for the second, and should be used about three weeks after the second. Find the amount of mixture needed to spray seven acres of trees three times.

15. The material for the fourth spraying should be made with $\frac{1}{4}$ lb. of Paris green in 50gal. of water and applied about seven weeks after the third spray. Approximate the amount of Paris green needed for seven acres of trees.

16. How many pounds of Paris green will a farmer need to spray 18 apple trees for one season?

17. If arsenate of lead is used at the rate of 1.5 lb. to 50 gal. of water instead of Paris green, how much of this poison is needed for one acre of fruit during one season?

134. Efficiency of Spraying Materials

Experiments in spraying apple trees were carried on by the Kansas Experiment Station for the purpose of demonstrating the relative value of spraying fruit trees and the relative value of lime sulphur and Bordeaux mixture as fungicides. Arsenate of lead was added to each fungicide. These experiments were carried on and reported by T. J. Headlee in Bulletin 174 of the Kansas Station. Seven orchards were chosen for the experiment and a part of each was divided into three equal "plats," each of which contained an equal number of trees. The accompanying table on page 189 is a summary of the results obtained.

1. What per cent of the Ganos was merchantable after a treatment of lime sulphur and Bordeaux, respectively?

2. Find the per cent of merchantable Ganos gathered from the unsprayed trees.

3. Find the average yield of merchantable fruit per tree of the sprayed Shacklefords. Likewise find the yield per tree when no spray was used.

4. Find the average yield of merchantable fruit per tree of the Mo. Pippins in the Barnes Orchard where the sprays were used. In like manner find the average yield per tree where the treatment was not applied.

5. Which plot of Jonathans on the Coleman Farm had the largest per cent of culls.

6. Find the average yield per tree of merchantable fruit on each of the six plots reported from the Snyder-Roediger Farm.

7. On the basis of the average yield per tree on the Snyder-Roediger Farm, find the increase in the amount of merchantable fruit due to the use of each spray.

8. Summarize the results of the experiment by filling out Table 75.

TABLE 74

Spray	No. of trees	Variety and no. bu. of merchantable fruit	Bushels of cull fruit
Coughlin's Orchard —			
Bordeaux	5	7.85 Gano	6.60
Bordeaux	5	22.14 Shackleford	5.67
Lime sulphur	5	8.30 Gano	5.45
Lime sulphur	5	15.76 Shackleford	5.53
No spray	5	.60 Gano	7.80
No spray	5	1.59 Shackleford	2.14
Barnes's Orchard —			
Bordeaux	10	30.50 Mo. Pippin	4.70
Lime sulphur	10	29.25 Mo. Pippin	5.10
No spray	10	5.15 Mo. Pippin	5.20
Snyder-Roediger Orchard —			
Bordeaux	10	71.30 Jonathan	5.50
Bordeaux	3	24.48 Mo. Pippin	5.43
Lime sulphur	10	78.70 Jonathan	6.40
Lime sulphur	3	25.44 Mo. Pippin	9.48
No spray	10	37.30 Jonathan	4.60
No spray	3	15.66 Mo. Pippin	8.40
Coleman's Orchard —			
Bordeaux	4	2.25 Jonathan	5.76
Lime sulphur	2	7.37 Jonathan	5.80
No spray	4	.64 Jonathan	5.20
Buckmaster's Orchard —			
Bordeaux	4	33.80 Winesaps and Ben Davis	1.08
Bordeaux	2	9.00 Mo. Pippin	3.24
Lime sulphur	4	34.26 Winesaps and Ben Davis	1.36
Lime sulphur	2	3.48 Mo. Pippin	1.00
No spray	4	15.84 Winesaps and Ben Davis	3.48
Fergus Orchard			
Bordeaux	6	74.6 Several varieties	3.50
Lime and sulphur	6	90.0 " "	12.00
None	6	.35 " "	6.80
Tredway Orchard —			
Bordeaux	6	44.34 Varieties	3.94
None	6	16.98 "	8.82

TABLE 75

Summary of gains in commercial fruit yield through careful spraying

Variety and farm	Increase in actual yield in bu. per tree		Increase in percentage of merchantable fruit	
	Bordeaux	Lime sulphur	Bordeaux (per cent)	Lime sulphur (per cent)
Gåno on Coughlin Farm	1.45	1.54	..	..
Shackleford on Coughlin Farm	4.11	2.82	..	..
Jonathan on Coleman Farm	.32	1.35	..	..
Jonathan on Snyder-Roediger Farm	3.40	4.14	..	..
Mo. Pippin on Barnes Farm	2.54	2.41	..	..
Mo. Pippin on Snyder-Roediger Farm	3.94	..	..	..
Mo. Pippin on Buckmaster Farm	4.50	..	..	..

135. Spraying for Commercial Fruit

1. In the experiments carried on at the Kansas Station, 2 lb. of arsenate of lead were added to 50 gal. of the Bordeaux mixture. A like amount of arsenate of lead was added to 50 gal. of the lime-sulphur mixture. The average cost per tree for Bordeaux mixture and arsenate of lead for the first treatment was \$.028, for the second treatment \$.0353, and for the third treatment \$.0437; the average cost of the labor per tree was \$.065, \$.0857, and \$.0636, respectively. Find the total cost per tree of the Bordeaux treatment and the arsenate of lead, including labor.

2. Find the net gain resulting from spraying the Shackleford trees upon the Coughlin Farm if the merchantable apples were sold on the trees at 50¢ per bushel.

3. The average cost per tree for the lime-sulphur treatment was as follows: first treatment \$.0318, for the second \$.06, for the third \$.064 per tree. The average cost per tree for the labor in applying the three treatments was \$.1928. Find the entire cost of spraying the 10 Jonathan trees on the Snyder-Roediger Farm.

4. The increased yield on the 10 trees was approximately 41.40 bu. Valuing these apples at 50¢ per bushel on the trees, what was the net profit of this treatment?

TABLE 76

Spraying Results on Coughlin Farm, Argentine, Kansas

	Total No.	Codlin moth	Curculio	Scab	Apple blotch
Bordeaux Plat — Trees Nos. 2, 5, 6, 9, 10 — Variety Gano					
Windfalls	1018	103	755	83	1
Picked fruit	2447	156	2318	164	20
Lime-Sulphur Plat — Trees Nos. 2, 5, 6, 9, 10 — Variety Gano					
Windfalls	708	78	632	50	..
Picked fruit	2590	228	2501	229	162
Check Plat — Trees Nos. 3, 5, 6, 9 — Variety Gano					
Windfalls	1259	602	1251	541	71
Picked fruit	1284	733	1283	850	143

NOTE — "Check Plat" was the one not treated.

5. As a result of applying the Bordeaux mixture, find the number of windfalls that were affected by the codlin moth, curculio, scab, and apple blotch, respectively, when the Bordeaux mixture was used.

6. Find the per cent of windfalls not affected by any of the destructive agencies referred to in problem 1.

7. What per cent of picked fruit treated with Bordeaux was infected with codlin moth, curculio, scab, and apple blotch, respectively?

8. What per cent of the total number of Ganos treated with the Bordeaux was infected with codlin moth, curculio, scab, and apple blotch, respectively?

9. What per cent of windfalls from the lime-sulphur trees was infected with codlin moth, curculio, scab, and apple blotch, respectively?

Optional Problems

10. In like manner determine the per cent of the picked fruit that was infected by each of the agencies referred to in problem 5.

11. Determine the total per cent of apples infected by each of these pests after the use of the lime-sulphur treatment.

12. Note the results obtained from the Gano trees not treated. Obtain the per cent of windfalls that were infected with codlin moth, curculio, scab, and apple blotch, respectively.

13. In like manner obtain the per cent of picked apples so infected.

14. Find the total per cent of apples in this group attacked by the different pests.

136. Measurements for the Planting of Orchard and Garden Fruits

TABLE 77

Name of fruit	Distance between rows	Distance in rows
Standard apples	30 ft.	30 ft.
Dwarf apples	12 "	12 "
Standard pears	20 "	20 "
Strong growing cherries	20 "	20 "
Smaller cherries	18 "	18 "
Standard plums	16 "	16 "
Standard peaches	16 "	16 "
Standard apricots	16 "	16 "
Standard nectarines	16 "	16 "
Dwarf pears	16 "	16 "
Grapes	10–16 "	7–16 "
Currants and gooseberries	4 "	4 "
Raspberries and blackberries	6 "	4 "
Strawberries (field culture)	3 "	1 "
Strawberries (garden culture)	2 "	1 "

NOTE — The above distances are for a good soil. If the soil is light the distances should be increased. The distances represent the amount of room needed by the mature plants, and does not mean that there shall be no planting between the rows while the plants are maturing.

1. 100 apple trees are planted in 10 rows 30 ft. apart, and the trees are planted 30 ft. apart in the rows. A fence 15 ft. from the trees extends around the orchard. What is the area of the orchard in square feet?

2. Find the number of square feet given to each tree in this orchard.

3. What relation, in per cent, does the area occupied by one tree bear to the area of the entire orchard?

4. Formulate a rule for determining the number of plants per given area, when the distance between the plants is given.

137. Small Fruits

1. First-class currant plants are quoted at \$6 per hundred or \$50 per thousand. What will it cost to supply the plants for an acre of currants?

(See Table 76.)

2. First-class gooseberry bushes are quoted at 20¢ each, or \$12 per hundred. Find the cost of the plants required to plant one acre.

3. First-class varieties of blackberry plants may be secured for \$2.50 per hundred or \$18 per thousand. What will the plants required to plant ½ acre of blackberries cost?

4. The best varieties of raspberries may be had for \$1.50 per hundred, or \$10 per thousand. Determine the cost of the plants necessary to plant 2.5 acres.

5. Assorted varieties of strawberry plants are quoted at 75¢ per hundred or \$5 per thousand. Determine the cost of the plants required for 1 acre in field culture.

6. Small orders of strawberry plants are usually delivered by parcel post. A 3-lb. package of plants delivered in the spring contains approximately 200 plants. Determine the cost of delivering 600 plants in the Second Zone.

(Get rate from postmaster.)

7. Plants delivered in the fall have more leaves, hence a 3-lb. package includes approximately 150 strawberry plants. If conditions are the same as in problem 6, what will the delivery of 600 plants cost?

8. Asparagus roots are furnished for $1 per hundred. Determine the cost of the plants required to plant 5 acres. The rows are spaced 3 ft. apart, and the plants are placed 18 in. apart in the rows.

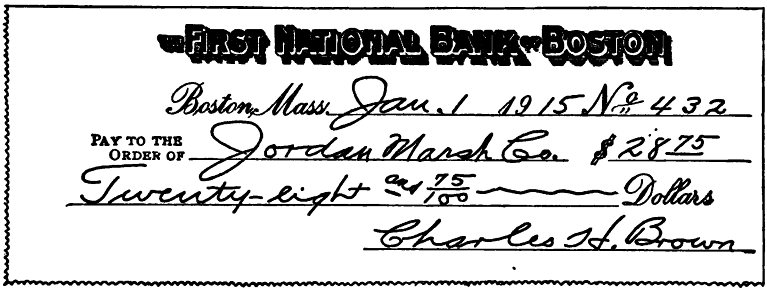
9. Extra selected grapes are quoted at $8 per hundred. Determine the cost of the plants necessary to plant 5 acres.

(Plants to be set 12 ft. by 10 ft. apart.)

10. Japanese barberry plants are quoted at $10 per hundred. Determine the cost of a sufficient amount of these plants to hedge four sides of a lot 80 ft. by 160 ft. Plants to be spaced 18 in. apart and 15 ft. to be taken out for walks and drives.

CHAPTER XX. BUSINESS FORMS

138. Forms of Credit


FIRST NATIONAL BANK OF BOSTON

Boston, Mass. Jan. 1 1915 No. 432

PAY TO THE ORDER OF Jordan Marsh Co. $28 75

Twenty-eight and 75/100 Dollars

Charles H. Brown

FIGURE 25

The personal check is the most common way of paying bills. For example, Charles H. Brown owes Jordan Marsh Co. a bill of $28.75. He has money in the First National Bank of Boston. Instead of drawing from the bank the money with which to pay the bill, he sends the firm a personal check for the $28.75. The firm takes the check to the bank with which it does business and is given credit for $28.75. A check not drawn upon the bank in which it is deposited is sent to a bank which clears accounts for a number of banks. This Clearing-House Bank gives the local bank which sends in the check credit for its face value. In this case the bank where Jordan Marsh Co. deposit is given credit for $28.75 and the First National Bank is made debtor for the same amount. Thus we see that each bank may do a considerable amount of business with checks and have very little money change hands. It is estimated that about ninety per cent of the business of the country is done through checks because of the ease and safety of this method of exchanging money. The majority of the business of the country could not be done if money had to change hands in every transaction. When credit in a country becomes unsound and the people demand money in payment of bills then there is a shortage of money which is called a financial stringency.

1. Make out a personal check to your groceryman for the weekly grocery bill. Endorse the check with his name. That is, turn the check face down and write across the left-hand end, and about an inch from this end, the name of the payee as it is written on the face of the check.

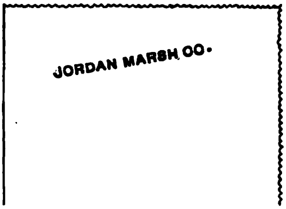


FIGURE 26

2. Make a check to the Curtis Publishing Company for one year's subscription ($1.50) for the *Saturday Evening Post.*

3. If the subscription for the *Saturday Evening Post* is $1.50 per year, and the paper can be purchased from newsboys for 5¢ each, what can be saved during the year by subscribing for the paper?

4. When checks are sent to a distant village or city some banks charge a small fee for cashing the checks. This fee is for sending the checks through the clearing-houses and is called exchange. If the exchange on the check sent to the Curtis Publishing Company is 10¢ and the postage 2¢, what does each weekly issue of the paper cost?

NOTE — Certified checks or Cashiers' checks are frequently used in paying bills in distant cities. A certified check is one on which the certification signed by the cashier is stamped across the face of the check. A cashier's check is one drawn upon the bank fund and signed by the cashier.

Another familiar way of paying bills with firms out of one's home city is by the use of the *bank draft.* Each bank has an established credit with some bank in a large banking center. If a man wishes to pay a bill for $75 to a firm in Philadelphia, he goes to his local bank and buys a draft for $75. This draft is an order from the bank with which he is dealing to some bank with which they have credit to pay $75 upon receipt of the draft. Bankers usually charge a small fee for writing drafts. This fee is for exchange as in the case of checks.

5. A farmer bought a binder for $140 and gave his note for one year at 6% interest. At the end of the year he sent a draft to pay off this note. If the local bank charged 5¢ for exchange, what did the binder cost him?

6. Mr. Wilson purchased $76 worth of merchandise, for which he received a discount of 6%. If he paid this bill with a draft, which cost him 10¢ exchange, what did the merchandise cost?

Two common methods employed in sending money to firms or people at long distances are the *Postal Money Order*, and the *Express Money Order*. Postal money orders are usually employed by people in the country who have no checking account in a bank. Express money orders are usually used for sending money to foreign countries.

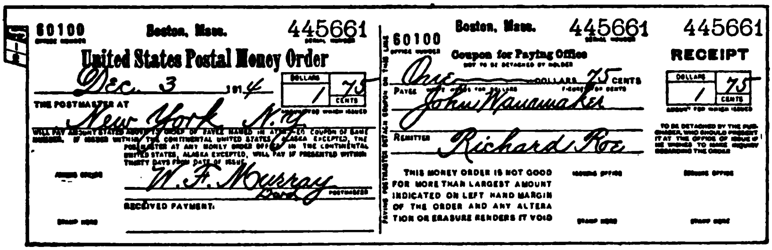


FIGURE 27

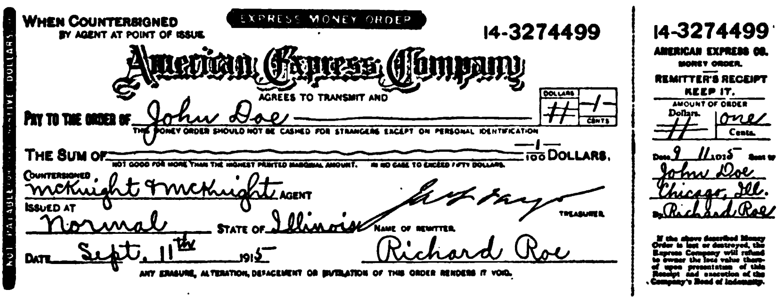


FIGURE 28

TABLE 78

Rates for Postal Money Orders

Not over	$2.50			3¢
From	2.51	to	$5.00	5¢
From	5.01	to	10.00	8¢
From	10.01	to	20.00	10¢
From	20.01	to	30.00	12¢
From	30.01	to	40.00	15¢
From	40.01	to	50.00	18¢
From	50.01	to	60.00	20¢
From	60.01	to	75.00	25¢
From	75.01	to	100.00	30¢

NOTE — If a money order for more than $100 is desired, it will cost a rate of 30¢ plus the rate of a money order for the amount over $100. For example, the rate of a money order for $123 will be 30¢ plus the rate of a money order for $23 or a total of 42¢. In this case two orders would have to be taken, as $100 is all that is allowed on one order.

7. Find the rate of money orders for $138, $176, $221, $435, $12.34, $17.65, and $5.46 respectively.

8. A farmer sent a money order to a nurseryman for 12 apple trees costing 15¢ each; 50 peach trees at 10¢ each; 25 shade trees at 50¢ each. What was the rate on this money order?

9. A postmaster wrote money orders for the following amounts the last week in December: $.75, $1.25, $3.60, $5, $8.40, 30¢, $4.20, $6.80, $2.20, 90¢, $12.60, $25, and $15. How much did the post office receive for writing these money orders?

139. Bills and Like Forms

When a purchaser receives a shipment of goods he usually receives with it a bill or invoice, which is a record or itemized list of the goods included in the shipment. It may or may not include a list of the prices. Invoices are for the convenience of the shipping clerk in checking shipments before they are made and for the convenience of the receiver of the goods to insure against a loss in shipment or a possibility of any goods having been omitted from the shipment.

At the opening of a month following the shipment of a bill of goods the firm shipping them sends an itemized bill, which includes the price of each article and the total of the bill. Usually the purchaser returns it to the firm

Terms Cash. *Plainfield, N. J.,* Mar. 1st 1915

Mr. G. L. Stevens

To **W. H. SULLIVAN,** Dr.

PLUMBER AND GAS FITTER

62 CHESTNUT STREET, Opposite the Railroad Station

Feb.	17	2 ft. ½ in. Brass pipe		64		
"	"	1 Union		50		
"	"	½ lb. Solder		20		
"	"	Labor repairing pipe	1	70	3	04
		Paid				
		W. H. Sullivan				

FIGURE 29

with a check or draft, and the shipping firm receipts the bill and returns it to the purchaser of the goods. It is then a *receipted bill.* If the purchaser fails to pay for the goods during the month in which the bill was sent, he is sent another bill which does not include an itemized list of the goods sent but merely shows a total of the amount due the firm. This form is called a *monthly statement.*

1. Write a bill for the following shipment of plants: 24 cherry trees at 15¢ each; 24 peach trees at 10¢ each; 100 apples trees at 10¢ each; 100 shade trees at 50¢ each; 400 strawberry plants at 20¢ per hundred.

140. Contracts

A contract is an agreement between two parties for the purpose of exchanging property or for the carrying out of some transaction. When the contract involves a considerable amount of money or extends over a considerable length of time it is always written to avoid misunderstandings between the contracting parties. A contract may or may not be signed in the presence of witnesses or in the presence of the other contracting party. Contracts are usually made by an exchange of letters excepting in the sale of real estate when a formal contract is drawn. (See pp. 201 and 202.)

1. A farmer contracted for 160 acres of land at $37.50 per acre. He paid $300 when the contract was signed and the rest when the abstract and deed were satisfactory. How much did he pay on receipt of the deed?

2. Mr. Wilson contracted for 440 acres of timber land at $34 per acre. On signing the contract, he deposited $500 in the bank with the instructions that it be turned over to the party selling the land when he furnished a satisfactory deed. How much additional cash was Mr. Wilson required to pay to close the deal provided he gave a mortgage for $6000?

3. A gentleman contracted to supply 80 qt. of milk per day to a milk supply house, at 14¢ per gallon. If the supply house sold the milk at $8\frac{1}{2}$¢ per quart, how much more did it get for the milk in one year than it paid for it?

4. A wholesale house contracted to supply one car of mellons per day to a large retail house. If the cars averaged 850 mellons each how much did the wholesale house clear in 30 days if it cleared 4¢ per mellon?

CONTRACT FOR SALE OF REAL ESTATE

THIS AGREEMENT, made and entered into this first day of January, in the year 1916, by and between John Doe, of the County of Cook, and State of Illinois, party of the first part, and Richard Roe, of the County of Cook, and State of Illinois, of the second part.

WITNESSETH, That the said party of the first part hereby sells to the said party of the second part, the following described real estate, to-wit:

All of Section 27, Township 125 North, Range 16 East of the Third Principal Meridian, consisting of six hundred forty acres, situated in the County of Adams, in the State of Illinois, for the sum of sixty-four thousand dollars.

The said party of the first part hereby covenants and agrees to convey the said premises above described to the said party of the second part, by a good and sufficient warranty deed, executed by the party of the first part, together with the lawful wife of said party of the first part in due form of law, which deed shall be delivered to the said party of the second part upon payment being made as herein provided, on or before the first day of March, 1916.

The said party of the first part also agrees on or before the fifteenth day of February, 1916, to furnish to the said party of the second part a complete abstract of title to said premises brought down to date of sale, certified to by a competent abstracter, showing the title to said premises free and clear of any and all encumbrances save and except taxes and drainage assessments not due, and allow the said party of the second part a reasonable opportunity to have said abstract examined. The taxes of said premises for the year 1916 are to be paid by the said party of the second part. Possession of said premises is to be given to the said party of the second part on or before the first day of March, 1916.

On his part, the said party of the second part agrees to pay the said sum of sixty-four thousand dollars, in the manner following: five hundred dollars cash in hand, upon the execution of this agreement, receipt whereof is hereby acknowledged: thirty thousand dollars in the form of a note bearing five percent interest, maturing in eight years, and guaranteed by a mortgage on the above described real estate, and the remainder in cash upon the first day of March, 1916, and on the receipt of the deed as herein above provided.

Deed to be delivered at the office of Thomas Powers.

It is mutually agreed by and between the parties hereunto, that the covenants and agreements herein contained shall extend and be obligatory upon the heirs, executors, administrators, and assigns of the respective parties; that time is of the essence of this contract, and that either party hereto, who shall fail or refuse to comply with the provisions of this contract on his part to be performed, shall forfeit and pay to the other party the sum of One Thousand Dollars ($1000), which sum is hereby fixed and agreed upon as the liquidated damage to be sustained by either party from failure or default upon the part of the other.

IN WITNESS WHEREOF, The parties to these presents have hereunto set their hands and seals to this agreement, in duplicate, the day and year first above written.

JOHN DOE .... (SEAL)

RICHARD ROE .... (SEAL)

.... (SEAL)

.... (SEAL)

WITNESS:

JAMES SMITH

....

No.........

Contract for Sale of Real Estate

JOHN DOE

WITH

RICHARD ROE

STATE OF ILLINOIS, } ss.
COUNTY OF Adams

This instrument was filed for record in the recorder's office of said County on the 3d day of January A.D. 1916, at 9 o'clock A M., and recorded in Book 4 of Contracts on page 233

HENRY WALLACE
Recorder.

By.......................... Deputy.

STATE OF ILLINOIS, } ss.
COUNTY OF Cook } I, John Stone a Notary Public in and for the........................said County, in the State aforesaid, do hereby certify that........................
....
John Doe

personally known to me to be the same person..whose name is subscribed to the foregoing instrument, appeared before me this day in person, and acknowledged that..he..signed, sealed and delivered said instrument as his free and voluntary act, for the uses and purposes therein set forth, including the release and waiver of the right of homestead.

Given under my hand and............seal, this 3d day of January A.D. 1916

JOHN COOK
Notary Public

(These forms are printed on the back of the contract, which is usually folded twice before filing.)

141. Deeds and Mortgages

In the sale of a piece of land or other real estate the seller and the buyer first make a contract which names the amount and the method of payment as shown on page 201. The seller then has an abstract prepared, and if this is suitable to the buyer, he proceeds to have a *Warranty Deed* prepared. When the date of selling the property arrives, the seller delivers to the buyer the warranty deed, and the buyer delivers to the seller money or other form of credit in payment for the warranty deed. If the buyer does not wish to pay the entire amount in cash, he may give his note for the balance, providing this arrangement is satisfactory to the seller. This note may be secured by a *Mortgage* or *Deed of Trust*, which gives the person holding the note power to have the property sold if the interest or principal is not paid when due. Such a sale is called *foreclosing* a *mortgage*. When the mortgage becomes due, the buyer of the land pays the seller the amount of the note in cash, plus the interest, and the seller delivers to the buyer the note, and with it a release of mortgage, or release deed.

All warranty deeds, trust deeds, mortgages, and release of mortgages should be taken at once to the recorder's office at the county seat wherein the real estate is located. Here they are recorded on the county books as proof that the real estate has a clear title. (See pp. 202–05.)

An *abstract* is a record of all transactions that have taken place regarding the sale or mortgaging of the real estate to be purchased. It shows whether there are unpaid taxes, mortgages or other assessments, which should be paid before the title is clear. In making contracts the seller usually agrees to furnish an abstract of title.

1. J. L. Jones sold 160 acres to R. C. Moore for $80 per acre. Mr. Moore gave Mr. Jones a warranty deed for the land, for which he received $5000 in cash and Mr. Jones's note secured with a mortgage for the balance. For how much did Mr. Jones give his note?

2. James Wilson purchased a tract of land. He paid part of the purchasing price in cash and gave his note for $8000 due in 5 years and secured with a trust deed. The note was drawn for 5% interest. How much interest did Mr. Wilson pay in the 5 years?

3. Mr. Smith owned a lot worth $1800, upon which he built a house at a cost of $8000. He paid the contractor $3000 in cash and gave his note secured by a mortgage on the property for the remaining $5000. Provided the loan was obtained at a 6% rate for a period of five years, and $1 was charged for recording the release deed when the note was paid, what was the total cost of the house?

4. Mr. A bought 160 A. of land from Mr. B, who had previously purchased it as a part of a 2500-A. tract from Mr. C. When Mr. B purchased the 2500 A. he paid part in cash and the rest with a personal note secured by a blanket mortgage on the entire tract. When B deeded the 160 A. to A he neglected to secure a release of mortgage from C for the 160 A. involved in the transfer to A. Later, when A discovered he had not a clear title to his land, he applied through his attorney for a release of the blanket mortgage upon it, which was given by C. If the land cost A $40 per acre, the cost of recording his deed was $1, his attorney's fee was $10, and the expense of recording the release deed was $1, what was the total cost of his farm?

WARRANTY DEED

THIS INDENTURE WITNESSETH, That the grantor John Doe of the City of Chicago, County of Cook, and State of Illinois, for and in consideration of the sum of thirty thousand dollars, in hand paid, Convey and Warrant to Richard Roe of the City of Chicago, County of Cook, and State of Illinois, the following described Real Estate, to-wit:

All of Section 27, Township 125 North, Range 16 East.....................

....

situated in the County of Adams, in the State of Illinois, and hereby release and waive all rights under and by virtue of the Homestead Exemption Laws of this State.

....

Dated this first day of March, A.D., 1916.

WITNESS:	
JOHN THOMPSON	JOHN DOE (SEAL)
....	.... (SEAL)
....	.... (SEAL)
	.... (SEAL)

No........

Warranty Deed

From .... JOHN DOE

To

RICHARD ROE

Chicago, Ill.

STATE OF ILLINOIS, } ss.
COUNTY OF Adams

This instrument was filed for record in the Recorder's office of said County on the 6th day of March A.D. 1916, at 8 o'clock A. M., and recorded in book 596 of Deeds on page 342

HENRY WALLACE
Recorder.

By........................ Deputy.

STATE OF ILLINOIS, } ss.
COUNTY OF Cook I, John Cook
a Notary Public in and for the........................said County, in the State aforesaid, do hereby certify that........................
John Doe
....

personally known to me to be the same person....whose name is subscribed to the foregoing instrument, appeared before me this day in person, and acknowledged that..he..signed, sealed and delivered said instrument as his free and voluntary act, for the uses and purposes therein set forth, including the release and waiver of the right of Homestead.

Given under my hand and........................seal, this 1st day of March A.D. 1916

JOHN COOK
Notary Public

(These forms are printed on the back of the deed, which is usually folded twice before filing.)

MORTGAGE

THIS INDENTURE WITNESSETH, That the Mortgagor, Richard Roe, of the City of Chicago, County of Cook and State of Illinois, MORTGAGES AND WARRANTS to John Doe, of the City of Chicago, County of Cook, and State of Illinois to secure the payment of thirty thousand dollars, to be paid according to one certain legal note.

....
....
....
....
....
....
....
....

all the following described real estate, to-wit:

Section 27, Township 125 North, Range 16 East of the Third Principal Meridian, consisting of six hundred forty acres;

....
....
....
....
....
....
....

situated in the County of Adams in the State of Illinois, hereby releasing and waiving all rights under and by virtue of the Homestead Exemption Laws of this State.

IT IS EXPRESSLY UNDERSTOOD AND AGREED, by and between the parties hereto, that if ....the above mentioned note...and the interest due thereon are not paid within thirty days after the said note...and interest...... thereon severally mature, then said note...with interest......thereon shall become due, and the Mortgagee may foreclose this mortgage for the entire debt, and the Court shall tax up, as part of the cost of said foreclosure suit, an attorney's fee for foreclosing the same not exceeding three hundred dollars.

....
....
....

Date this first day of March, A.D. 1916.

WITNESS:	
	RICHARD ROE ......(L. S.)
....	..................(L. S.)
....	..................(L. S.)

No. ....

Mortgage

....

RICHARD ROE

To

JOHN DOE

....

STATE OF ILLINOIS, } ss.
COUNTY OF Adams }

This instrument was filed for record in the Recorder's Office of said County on the 6th day of March A.D. 19 16 at 9 o'clock A. M., and recorded in book 12 of Mortgages on page 527

HENRY WALLACE
Recorder.

By ....
Deputy.

STATE OF ILLINOIS, } ss.
COUNTY OF Cook } I, John Cook
a Notary Public in and for the ....
said County, in the State aforesaid, do hereby certify that ....
Richard Roe
....

personally known to me to be the same person whose name is subscribed to the foregoing instrument, appeared before me this day in person, and acknowledged that he signed, sealed, and delivered said instrument as his free and voluntary act, for the uses and purposes therein set forth, including the release and waiver of the right of homestead.

Given under my hand and .... seal this 2d day of March A.D. 19 16

JOHN COOK
Notary Public

(These forms are printed on the back of the mortgage, which is usually folded twice before filing.)

RELEASE OF MORTGAGE

KNOW ALL MEN BY THESE PESENTS, That I, John Doe, of the County of Cook, and the State of Illinois, do hereby certify, that a certain Indenture of Mortgage, bearing date the first day of March, A.D. 1916, made and executed by Richard Roe of the first part, to John Doe of the second part, and recorded in the Recorder's office of Adams County, in the State of Illinois in Book 12 of Mortgages, on page 527,on the sixth day of March, A.D. 1916, is with the note accompanying it, fully paid, satisfied, released and discharged.

Witness his hand and seal...., this first day of March, A.D. 1920.

JOHN DOE ....(SEAL)

..............(SEAL)

Release of Mortgage

JOHN DOE

To

RICHARD ROE

STATE OF ILLINOIS } ss. No......
Adams COUNTY, }

This Instrument was filed for record in the Recorder's office of Adams County aforesaid, on the 4th day of March A.D. 1920 at 9 o'clock A. M., and recorded in Book 16 of Mortgages on page 437

HENRY WALLACE

Recorder.

(This form is printed on the back of the release of mortgage.)

142. Notes and Collateral

If one person owes another person money he may give his note for the amount, which is a promise to pay the money at some future date. The note may or may not bear interest. When a note bears the words "to order" or "to bearer" it is called a "negotiable" note. Most notes are negotiable.

$100.00 Logan, Utah March 12, 1915
Three months after date I promise to pay to
the order of John Crowell
One hundred and 00/100 Dollars
Payable at National Bank of Logan
Value received
No. 32 Due June 12, 1915 M. J. Case

FIGURE 30

A promissory note is secure if the giver of the note has property in his own right and exclusive of exemption laws, equal to or greater than the face of the note. In the absence of such property holdings promissory notes are usually secured by the signature of a second party who possesses property equal to the face of the note or who jointly with the giver of the note possesses property of such value.

Collateral. Ordinarily promissory notes are secured by what is commonly called "collateral." This consists of other notes, stocks of some sort, shares, mortgages or trust deeds upon property, etc. When such holdings are used as collateral they are temporarily transferred to the holder of the note subject to release when the note is paid.

1. Make a note for 1 year for $1200 with interest at 5% per annum.

2. What will be the total amount of this note at the end of 1 year?

3. Mr. Wilson needed \$500 cash for 90 days. He held 50 shares in a Building and Loan Company, but did not want to bear the loss which he would incur from canceling these shares before a dividend was declared. He used these shares as collateral and borrowed the money from a bank. For what amount did he give his note to the bank to obtain \$500 in cash, interest at 6%.

(Some banks draw notes so as to include the money borrowed plus the interest.)

4. A New Jersey farmer purchased 230 acres of reclaimed land at \$30 per acre, conditioned as follows: one tenth cash and one tenth of the remainder each year for 10 successive years. Each of the 9 payments was secured by a note bearing 5% interest. How much interest will this farmer have paid on these notes when the last one has been paid?

5. Mr. Brown borrowed \$5000 from the North Western Insurance Co. for 5 years at $5\frac{1}{2}$ % interest, and secured his note with a mortgage upon his farm. What is the semiannual interest due upon this loan?

6. At the end of 3 years money became cheaper and Mr. Brown obtained a \$5000 loan for the remaining 2 years at 5%, with which to pay the $5\frac{1}{2}$% loan. How much did he save in the remaining 2 years by this transaction?

7. In order to purchase an automobile a policy-holder in an "old-line" insurance company borrowed \$1085 upon his policy. What is his semiannual interest upon this loan if the rate is 6%?

8. A tenant farmer mortgaged his crops and stock for \$2780 to secure money with which to develop and harvest his crops. The note secured by the mortgage was drawn for 9 months at 6%. What was the amount due on the note at maturity?

9. A "loan shark" charged a tenant farmer \$5 for the use of \$25 for 9 months. What rate of interest did he charge?

10. A speculator bought 320 acres of land at \$61 per acre, which he rented for \$7 per acre. The taxes and other expenses amounted to \$1 per acre yearly. What rate of interest was made upon this investment?

11. An implement dealer bought \$15,000 worth of machinery from the International Harvester Company, with the option of 5% discount for cash (payment within 30 days). He decided to pay cash. How much did he pay the company on this bill?

12. A cotton planter harvested 40 bales of cotton averaging 500 lb. per bale. Cotton was worth 8¢ per pound at harvest time. He decided to hold the cotton and borrow \$1000 and secure it with a mortgage on the cotton. At the end of 4 months he sold the cotton for 12¢ per pound and paid off the loan with interest at 6%. What did he make by holding the cotton?

13. A farmer purchased \$3000 worth of non-taxable government bonds, paying 3% interest. He could have loaned this money at 6% interest, secured by a trust deed upon a good land property. If state, county, and local taxes amount to 1.33% on the dollar annually, how much did he lose each year by purchasing the government bonds?

143. Wills

A will is an instrument for disposing of a person's property after his death. In it he names the persons among whom his property is to be distributed and the amount each is to receive. If a person dies without making a will, his property is divided as required by law among his so-called "legal heirs." (See p. 213.)

1. If Nancy Rowe received \$8000 worth of 6% bonds, a 5% mortgage for \$16,000, a life insurance of \$25,000, which she loaned at 5% interest, and personal property which she sold for \$8640, which she loaned at 5%, what was the annual income from her inherited property?

WILL AND TESTAMENT

IN THE NAME OF GOD, AMEN

I, Richard Roe, of Chicago, in the County of Cook and State of Illinois, being of sound mind and memory, and considering the uncertainty of this frail and transitory life, do therefore make, ordain, publish and declare this to be my last

WILL AND TESTAMENT:

FIRST, I order and direct that my Executor hereinafter named pay all my just debts and funeral expenses as soon after my decease as conveniently may be.

SECOND, After the payment of such funeral expenses and debts, I give, devise and bequeath to my son, Richard Roe, Jr., all of section 27, Township 125 North of, and Range 16 East of the Third Principal Meridian, in the County of Adams in the State of Illinois.

THIRD, To my daughter, Nancy Roe, I give, devise, and bequeath the remainder of my property, consisting of bonds, mortgages, life insurance, and all personal property belonging to me at the time of my death.

LASTLY, I make, constitute and appoint Richard Roe, Jr., of Chicago, Cook County, Illinois, to be Executor of this, my last Will and Testament, hereby revoking all former wills by me made.

IN WITNESS WHEREOF, I have hereunto subscribed my name and affixed my seal, the first day of April, in the year of our Lord, One Thousand Nine Hundred and Sixteen.

RICHARD ROE (SEAL)

This instrument was, on the day of the date thereof, signed, published, and declared by the said Testator Richard Roe to be his last Will and Testament, in the presence of us, who at his request have subscribed our names thereto as witnesses, in his presence, and in the presence of each other.

WILLIAM SMITH
ROBERT WILSON

Last Will and Testament

of

RICHARD ROE

Made and published the 1st

day of April 1916

144. Insurance

The types of insurance most common in rural communities are fire insurance, tornado or wind insurance, hail insurance, and life insurance. Insurance rates vary according to the risk which the insurance company assumes. Life insurance rates increase with the age of the insured. Fire insurance varies with the danger of fire in the building insured. Tornado insurance varies with regard to the liability of tornadoes in the locality. The amount paid for insurance is called a premium.

1. A farmer paid a premium of $9.35 for a three-year period to insure his household goods valued at $1100. What rate did the agent charge him?

2. Mr. Adams insured his house for $3000 for a three-year period at a rate of $1.12 per $100. What was the amount of his premium?

3. A man aged 35 took out a 20-year endowment life insurance policy for $4000. If the premium for that age is $33.40 per $1000, how much will he pay in premiums in 20 years?

4. What is the compound interest on these premiums for the 20 years?

(Compound interest = interest on principal and also on accrued interest which thus becomes an addition to the principal.)

5. A man took out 3 life insurance policies: a $3000 "twenty pay" policy with an annual premium of $35 per thousand; a $2000 twenty year endowment policy with an annual premium of $50 per thousand; and a $10,000 "straight life" policy at $14.50 per thousand annually. What was his total yearly payment in premiums?

145. Lease

When a man owning a farm or house rents it to another, there is drawn up a lease or agreement between them as to the care and management of the property, the payment of rentals, and time of possession. (See pp. 215 and 216.)

FARM LEASE

THIS AGREEMENT, made and entered into by and between Richard Roe party of the first part, and David Jones party of the second part, this first day of March 1916,

WITNESSETH, That Richard Roe the party of the first part, hereby LEASE to said party of the second part, during the year commencing on the first day of March, 1916, and ending on the twenty-eighth day of February, 1917, the following described real estate in Adams County, Illinois, to-wit:

All of Section 27, ...

....

....

Township 125 North, of Range 16 East.

And the said party of the second part, in consideration of the premises and benefits to be derived from the use and occupation of the premises above described, hereby agrees and covenants with the first party.

1. To take good care of all buildings, fences and improvements upon said real estate; to properly cultivate and care for the hedges, trees and shrubbery of all kinds that may now be or hereafter put upon said premises, and keep them in as good order and repair as the same now are, natural wear and decay and unavoidable accidents only excepted, to furnish the seed for, and cultivate at his own expense, said real estate during the term aforesaid.

2. To cultivate said land as follows: To plow the land in breaking at least six inches deep, and to harrow and roll the same as much as is necessary to put it in good condition for planting, to plant the corn in check rows, that it may be plowed each way, and to plow the corn at least three times over.

3. To allow no stock upon said premises with burs upon them, nor to allow any cockle burs to grow on said land while in his possession.

4. To distribute all manure that may from time to time collect in any place or places upon said premises as the first party may direct; provided said manure shall not be removed off the premises hereby leased.

5. To keep all ditches and water courses clear from obstruction, so as to allow the water to drain off freely, and not to stand to the detriment of either pasture or plow land.

6. To pay to the first party a yearly rent of one half of all grain, stock, and other produce sold from the premises. Said party of the second part agrees to furnish an itemized account of all sales from the premises at the end of each month. Payment to be made on or before the first day of each month, in the manner aforesaid.

7. Not to assign this lease to any person or persons without the written consent of the first party endorsed thereon.

8. That the party of the first part shall have and hold a lien upon all the crops raised upon said premises to secure the full payment of all rents as stipulated in the sixth article of this agreement, and to secure the payment of all moneys advanced to said party of the second part while tending said grain.

9. To vacate said premises at the expiration of this lease without any notice to quit or any demand, and to deliver up the premises to the first party.

10. It is understood and agreed that if the party of the second part shall from any cause fail to comply with all his agreements herein, the said party of the first part may at any time when such failure occurs, take active possession of such premises and buildings thereon, which party of the second part agrees to surrender, and employ other persons to tend said crop and perform all the agreements of

the second party as herein contained as fully as the same are contemplated in this agreement, and after deducting all moneys advanced, all moneys or grain due for the rent, and the expense of attending said crop as aforesaid, to pay the residue, if any, to the second party.

11. It is hereby agreed that so soon as the crop shall be harvested and taken off the lands, or any portion of the lands rented, or said portion from which said crop or crops is taken, shall at such times be subject to the control of the first party, and said party may enter upon and fully possess and control such land or portion of land aforesaid as if the same had never been leased.

12. It is hereby agreed that all damages resulting to either party from any failure to comply with the terms of this agreement shall be collectible without any relief whatever from the valuation of appraisement laws of the State of Illinois.

WITNESS our hands and seals the day and year first above written.

Richard Roe (SEAL)
David Jones (SEAL)
.................................(SEAL)
.................................(SEAL)

No............

Farm Lease

To

DAVID JONES

Term begins March 1st, 1916

....

Expires February 28th, 1917

LAND RENTED

Section 27, Township 125 North, Range 16 East.

1. A company leased a business property for a term of 10 yr. at $140 per month. The property was sublet to three parties who paid monthly $60, $65, and $50, respectively, for the portions they occupied. How much did the company make in the 10 yr.?

2. What would the company have made had it leased the property for $125 per month?

146. Taxes

Taxes are assessed on real estate and on personal property. The rate of taxation in towns and cities is determined by the amount of money to be raised and the assessed value of the property held in the town or city. City or town property is taxed for the support of the local government, for the maintenance of the schools, for a share in the expense of the county, and of the state.

Persons paying taxes should obtain a tax receipt as proof of the fact that they have paid their taxes. This receipt should be regarded as a valuable paper since if the payment is not recorded or the receipt is lost owners of property can be forced to pay the taxes again or have their property sold for taxes. In case of selling property the tax receipts are sometimes asked for as proof that the title is clear.

1. A man paid $16.40 taxes on his personal property. Determine the assessed value of his property, if the tax rate was $4 per $100 assessed valuation.

2. A farmer owns 540 acres of land which is assessed $16 per acre as drainage tax. If this tax is distributed over a period of 20 years, what will his tax bill be per year for drainage only?

	State tax	County tax	Town tax	Outside tax	Corporation tax	School tax	Total tax
Town Taxes Tax on each $100 value State..............23¢ County............14¢ Town............. 3¢ *Road and Bridges* Outside of corporation 16¢ Inside of corporation 71¢ School........... $1.40							

NOTE — Tax rates vary in the various towns and districts of the county. They vary from year to year also.

3. Make a form similar to the one above and distribute in the proper columns the taxes upon property assessed at $560.

4. What was Mr. Johnson's taxes for various purposes upon real estate assessed at $950, and personal property assessed at $440? What was his total tax?

5. How much tax should Mr. Wilson pay if his real estate was assessed at $2700, and his personal property as follows: household goods at $528, and notes, stocks, etc., to the value of $3500?

	State tax	County tax	Bridge and road	School tax	Total
County Taxes State............23¢ County..........14¢ Bridge and road..20¢ School...........62¢					

6. Make a form similar to the above and make the proper distribution of Mr. Armstrong's taxes on the following assessed values: farm, $1850; stock, and farm implements, $780; household goods, $160; notes, $1200.

7. What was Mr. Jones's taxes on farm property assessed at $2160 and personal property assessed at $760?

8. Get a late tax receipt and determine the total tax rate for your district.

9. What are the taxes on property assessed at $640 by your assessor?

10. What are the taxes of a farmer in your neighborhood if his farm was assessed for $1850, his live stock for $800, his farm implements for $150, and his household goods for $180.

CHAPTER XXI. FARM ACCOUNTS[1]

147. Labor Report

A set of farm accounts kept in a practical way involves considerable labor, and a knowledge of the art of accounting.

The system of farm accounting presented here is not as simple as some systems, but it is sufficiently simple to meet the needs of any farm. Those desiring simpler accounts may modify this system. In fact no farm is best served by a system of accounts adapted to another farm. Each system must be modified to suit individual cases.

Students should be encouraged to keep a set of accounts related to their home farm, or household. This will be of much more value to them than the formal study of unfamiliar accounts.

The labor report is the most important item in farm accounts because it gives the manager an insight into the disposition of labor and aids him in its judicious expenditure. The labor report shown on page 220 gives an easy method of accounting both the man and horse labor of the farm for the entire month. There should be a sheet for each day of the month. By forwarding the totals one has ready access to the amount of labor each man is credited with. He also knows the total amount of labor credited to the horses. By checking the totals for the men with the totals for the work spent on the various departments of the farm one is certain as to the correctness of his accounts.

1. The labor report given on the next page is for June 29. Make out a similar report for June 30 and forward the grand totals for June 29 to the forward columns on the June 30 report.

2. On June 30, W. D. Brickey spent 1 hr. on horses, 1 hr. on poultry, 9 hr. on cattle, 2 hr. on hogs, and 1 hr. on corn. What was his total number of hours for the month of June?

3. Brickey was paid $75 per month for the month of June. What was his average wage per hour?

[1] A large part of the data on farm accounts is taken from Vye's *Farm Accounts*.

Year....,... Month, June Day, 29	W. D. Brickey	V. Morgan	E. Braun	C. Huffmaster	R. Matthew	E. Joosten	J. Marsh	F. Carr	H. Willey		Total	Forward	Grand total		Horses	Forward	Total
Real estate..									1½		1½	46	47½			1¼	1¼
Machinery ..	1½				¼						1¾	20¼	22			1	1
Horses......	1	1½									2½	85¼	87¾			6	6
Cattle.......	9		3	3	13	3					31	897½	928½		4	24	28
Hogs........	1										1	39	40			½	½
Poultry......	1										1	49	50			17	17
Corn........		9½									9½	238½	248		19	345½	364
Oats.........												25½	25½				
Wheat.......												1	1				
Clover......																	
Alfalfa......												25¼	25¼		12	130	142
Total........	13½	11	3	3	13¼	3			1½		48¼				35		
Forward.....	359¾	279¾	90¼	84½	356½	41½	57	86	72			1427¼				525¼	
Grand total .	373¼	290¾	93¼	87½	369¾	44½	57	86	73½				1475½				560¼

NOTE — The above table shows how many hours each man and the several horses gave to the various interests of the farm in June. For example W. D. Brickey worked 1½ hr. with machinery, 1 hr. with the horses, 9 hr. with the cattle, 1 hr. with the hogs, and 1 hr. with the poultry on June 29th. At the bottom of the table is shown the number of hours each man worked on June 29th, the number of hours each man had worked in June previous to June 29th, and also the number of hours each man has worked in the 29 days of June.

The three columns on the right-hand side (headed "Total," "Forward," and "Grand Total" respectively) show the number of hours the men have given (1) to the various interests of the farm on June 29th, (2) on the previous days of June, and (3) for the 29 days of June. Other columns show how many hours of horse labor were given to each of the farm interests for the same days of June.

4. On June 30, Morgan spent 1.5 hr. on horses, and 10 hr. on corn. What was his total number of hours for the month of June?

5. Morgan was paid \$50 for his labor for the month. What was his average wage per hour?

6. Braun, Huffmaster, and Joosten spent 3 hr. each on the cattle on June 30. What was the total number of hours for each one of the men for the month of June?

7. These men were paid at the rate of 17.5¢ per hour. What amount did each earn during the month?

8. Matthew worked .5 hr. on real estate and 13 hr. on cattle on June 30. What were his total hours for June?

9. He was paid at the rate of \$60 per month. What was his rate of wage per hour?

10. Willey worked 1.5 hr. on real estate on June 30. What was his total number of hours for June? What did he earn at 17.5¢ per hour?

11. Marsh and Carr did not work on June 30. What did each receive for the month at 17.5¢ per hour?

12. What was the total number of hours for all the men during the month of June?

13. What was the average wage per hour for the month?

14. What was the total amount of horse labor for June, if on June 30 the horses spent 3 hr. on cattle, 24 hr. on corn, and 8 hr. on alfalfa.

15. Complete the labor report for June for the horses.

Optional Problems

16. The horse labor was figured at 10¢ per hour. There were 4 horses on the farm. What was the income per horse for June?

17. What amount of the horse labor for month of June should be charged to the corn?

18. What was the total pay-roll for the month on the farm?

19. What amount of the pay-roll for June 29 and 30 should be charged to the cattle?

20. The average daily income from the sale of milk for June 29 and 30 was $17.50. What per cent of this income was spent for labor?

21. The cost of the feed for the two days was about $12. What was the income above feed and labor?

22. What was the daily income above feed and labor?

23. What would be the yearly net income of the herd at this rate?

24. Make out a labor report for your home farm for one week.

148. Milk Records

Another feature of farm accounts essential on all farms where cows are kept is the milk record. By keeping a careful milk record it is possible to detect cows that are not profitable. Under proper conditions it is little trouble to weigh the milk from each cow at the time of milking, and to test for butter-fat on the 5th, 15th, and 25th of each month.

These results should be recorded in proper form. Students should keep a milk record of their cows at home as a part of their exercises in rural arithmetic. The milk record shown on page 223 is for 5 Holstein-Friesian cows. The milk was weighed after each milking. It was tested three times during the month and the average of the tests recorded.

1. Find the total amount of milk produced by each of the 5 cows for the 31 days.

Note — the weights of milk are recorded in pounds and tenths of pounds.

2. What was the average daily production of each cow?

3. What was the total amount of butter-fat produced by cow No. 1 during the month?

4. What was the total amount of butter-fat produced by cows Nos. 2, 3, 4, and 5?

MILK RECORD

HERD OF........................FROM APRIL 30, 1915, TO MAY 31, 1915

Cow Number		1	2	3	4	5	Cow Number		1	2	3	4	5
Date		lbs.	lbs.	lbs.	lbs.	lbs.	Date		lbs.	lbs.	lbs.	lbs.	lbs.
1......	A.M.	14.5	14.7	13.1	10.4	13.8	18....	A.M.	16.6	15.2	15.8	10.8	18.3
	P.M.	19.	16.3	16.1	13.	15.5		P.M.	19.2	15.1	17.6	10.1	18.3
2......	A.M.	14.5	14.	13.1	10.	15.3	19....	A.M.	16.2	16.	14.4	10.3	18.6
	P.M.	18.4	13.8	14.5	13.1	9.5		P.M.	19.	16.	16.9	11.8	18.8
3......	A.M.	18.9	13.2	13.3	10.5	16.5	20....	A.M.	15.1	16.1	14.4	9.4	18.
	P.M.	20.2	14.5	17.9	13.6	18.3		P.M.	17.3	17.	15.3	10.7	18.5
4......	A.M.	18.5	13.	14.8	12.	15.5	21....	A.M.	16.2	16.	15.	9.5	14.
	P.M.	18.	16.5	19.1	14.	18.5		P.M.	17.1	18.5	16.	11.8	20.5
5......	A.M.	15.5	16.4	17.	12.	16.5	22....	A.M.	15.3	16.	15.4	9.7	17.
	P.M.	18.4	16.5	16.7	13.4	20.		P.M.	17.3	17.8	15.6	11.	18.
6......	A.M.	17.6	15.8	14.4	11.	16.3	23....	A.M.	17.2	15.5	14.6	9.6	16.5
	P.M.	15.7	18.2	15.7	12.	18.9		P.M.	17.	18.	19.5	12.3	20.8
7......	A.M.	15.6	15.3	14.6	10.5	14.3	24....	A.M.	16.3	17.3	16.	10.6	18.3
	P.M.	17.5	18.	16.5	11.8	20.7		P.M.	18.1	18.	18.7	13.3	20.7
8......	A.M.	14.4	15.2	13.	8.5	12.	25....	A.M.	16.2	17.1	16.5	11.	17.
	P.M.	14.2	17.5	16.5	11.7	23.5		P.M.	18.4	17.9	15.8	10.	18.2
9......	A.M.	13.9	15.	13.7	8.6	12.	26....	A.M.	17.3	18.1	17.	10.	18.
	P.M.	16.	16.7	16.3	11.2	30.		P.M.	18.1	19.	17.7	9.1	18.5
10......	A.M.	15.2	16.4	14.5	9.2	13.	27....	A.M.	14.2	15.5	14.8	9.	15.9
	P.M.	16.5	16.	17.1	11.2	21.		P.M.	18.5	18.	16.6	8.9	19.
11......	A.M.	15.8	15.	15.1	10.1	15.	28....	A.M.	15.4	17.5	16.	8.6	17.5
	P.M.	16.2	16.1	17.6	16.3	20.5		P.M.	16.9	18.3	18.6	10.3	19.
12......	A.M.	15.5	16.8	16.2	9.3	13.1	29....	A.M.	15.2	16.5	14.6	9.	18.
	P.M.	16.2	16.	16.1	9.5	20.5		P.M.	18.4	19.	17.4	11.3	20.5
13......	A.M.	14.	14.7	15.1	9.5	12.6	30....	A.M.	15.4	17.	16.5	9.5	19.
	P.M.	16.3	18.	15.3	10.8	19.2		P.M.	18.3	19.5	17.3	10.9	20.
14......	A.M.	15.1	16.	15.6	8.6	16.5	31....	A.M.	16.1	16.5	16.	10.1	18.
	P.M.	15.4	17.2	18.5	11.4	17.5		P.M.	20.	18.2	16.8	11.	21.
15......	A.M.	15.	16.3	15.3	10.3	16.							
	P.M.	18.8	17.	17.9	11.5	21.3							
16......	A.M.	15.	16.3	16.8	10.4	14.2	Average per cent fat....		3.5	3.16	3.5	3.7	3.35
	P.M.	15.5	16.	17.8	11.1	21.2							
17......	A.M.	16.1	15.2	16.	10.2	17.2	Total fat income......						
	P.M.	17.2	15.2	17.5	11.6	18.5							

5. What was the average daily butter-fat production of each of the cows?

6. If the butter-fat was sold for 32¢ per pound, what was the income from each cow for the month?

7. What was the average daily income from each cow?

8. What was the total income from the herd for the month?

9. There are 2.18 pounds of milk in 1 qt. How many quarts of milk did each cow produce during the month?

10. What was the average per cent of butter-fat in the milk produced by the 5 cows for the month?

11. Butter made in home dairies usually contains about 80% butter-fat. How many pounds of butter would the butter-fat produced by the herd for the month make?

Optional Problems

12. What was the average daily butter yield of each cow?

13. If instead of selling the butter-fat at 32¢ per pound it had been made into butter and sold for 35¢ per pound, what would have been gained for the month on this labor?

14. If the dairyman owning these cows had sold the milk at 8¢ per quart, what would have been the income from the herd for the month?

15. Make out a milk record for your home herd for the month, and determine each cow's income at the end of the month.

149. Inventory of F. C. Hibbard Farm

An inventory of a farm is the estimated cash value of the various properties of the farm including the real estate. Inventories are a necessary feature of farm accounting.

INVENTORY OF F. C. HIBBARD FARM FEBRUARY 1

Real Estate			
S.E. ¼ Sec. 4 Twp. 111 Range 19 160 A. @ $60.			$9600.
Horses			
2 Black mares	6 years old	$200.	
Gray mare	14 " "	125.	
Gray gelding	16 " "	75.	
Brown mare	2 " "	40.	
" "	1 " "	20.	460.
Cattle			
Grade Shorthorn	2 " "	30.	
White heifer	2 " "	25.	
Red heifer	2 " "	25.	
Crossy	6 " "	30.	
Whitey	10 " "	25.	
Durham	8 " "	30.	
Black & white Jersey	8 " "	25.	
Dot	10 " "	30.	
Star	7 " "	25.	
Bangs	2 " "	25.	
Holstein	6 " "	22.	
Daisy	1 " "	10.	
Bell	1 " "	18.	
Bess	1 " "	10.	
2 Red & white steers		95.	
Grade Shorthorn		20.	
5 Calves		41.	486.
Hogs			
8 Hogs		92.	
3 Brood sows @ $15.		45.	
8 Hogs		66.20	203.20
Poultry			
90 Chickens @ 33⅓		30.	30.
Machinery & Implements			
1 Lumber wagon		25.	
1 " "		5.	
1 Road wagon		45.	
1 Surrey		55.	
1 One horse buggy		5.	
1 Pair light bobs		10.	
1 Cutter		15.	
1 Binder		15.	
1 Mower		18.	
1 Hay rake		3.	
1 Seeder		28.	
1 Fanning mill		20.	
1 Corn sheller		5.	
1 Cream separator		40.	
1 Hay fork and rope		6.50	
1 Grindstone		.75	
1 Sulky plow		35.	
2 Walking plows		5.	
1 Spring tooth harrow		7.	
1 Wood frame borrow		3.	
1 Disc		10.	
1 Cultivator 2 horse		20.	
1 " " "		4.	
1 " 1 horse		2.	
3 Forks		1.25	
1 Scoop shovel		.75	
Small tools		2.	
1 Set barn scales		8.	
1 Set double harness		20.	

INVENTORY CONTINUED FEBRUARY 1

Forward		
1 Set double harness	$ 5.	
1 Set double harness light	25.	
Blankets	3.	$447.25
Oats 34¢ per bu.		512.72
Barley 35¢ per bu.		72.70
Corn 35¢ per bu.		131.95
Corn fodder		17.82
Hay $6.00 per ton		274.48
House Furnishings		
2 Kitchen ranges	30.	
2 Tables	10.	
9 Chairs	15.	
4 Rocking-chairs	7.	
6 Kitchen chairs	2.	
1 Upholstered chair	5.	
2 Upholstered chair	5.	
1 Bedroom suites	15.	
2 " "	20.	
1 " "	5.	
Carpets	30.	
Bedding	50.	
2 Couches	5.	
1 Cot	1.	
1 Parlor table	2.	
1 Sideboard	15.	
1 Wardrobe	50.	
1 Desk	15.	
1 Desk	5.	
1 Clock	4.	
1 Piano	150.	
Kitchen utensils — stove ware	5.	
Dishes	25.	
Refrigerator	15.	
Churn	2.	488.
Clothing		
Men's	60.	
Women's	75.	135.
Food and Fuel		82.40
Cash on hand		429.91

1. Find the total cash valuation of the properties on the Hibbard Farm not including real estate and cash.

2. What per cent of the value of the real estate was the value of the personal property?

3. What was the total investment in real estate and personal property?

4. What is the interest on the total investment at 6%?

150. The Cash Account

The cash account on page 228 is suitable for the farm accounting. Cash should be thought of as a person and cash should be *debited* with all moneys paid into the cash account, just as a person receiving money is debtor for cash obtained. In the same way cash should be given *credit* for all moneys paid out of the cash account. The difference between the total of the debit column and the credit column is called the balance. In all cash accounts there is either no money *in the account* or there is a balance in the debit column. In other words the debit column is always equal to or greater than the credit column in a cash account. In other accounts the total of the debit and credit column may be equal or either one may be greater than the other. When the debit column of any other account but cash is the greatest the balance is written in the balance column in red ink to show a loss. It may help students of accounting if each thinks of himself as a person called *cash.*

1. How much money did Mr. Hibbard have on hand February 1?

2. What was his cash balance on the evening of February 9?

3. What were the cash receipts from February 3 to February 14, inclusive?

4. What was the cash expenditures from February 3 to February 14 inclusive?

5. What was the cash balance on the evening of February 14?

6. Find the total cash receipts for February.

7. Find the total cash expenditures for February.

8. What was the cash balance on the Hibbard Farm March 1?

9. What were the average daily cash receipts for the month of February?

10. What were the average daily cash expenditures for the month of February?

11. What was the average daily balance for the month of February?

CASH ACCOUNT No. 3

Date	Title	Explanation	Post to No.	Debits	Credits	Balance
Feb. 1	Balance			$429.91		
" 3	Cattle	Cream 1 gal. Butter 4½ # @ $1	5	1.80		
" 5	Farm Expenses	Personal property tax	17		$6.51	
" 5	Family Expenses	Medicine 50¢ Stationery 27¢	16		.77	
" 5	Farm Expenses	Binder twine	17		22.50	
" 5	Food & Fuel	Wood $8.00 Kerosene 15¢	15		8.15	
" 5	Oats	81 bu. 8 # @ 35¢	9	28.44		
" 5	Cattle	Cream 5½ qts. @ 20¢	5	1.10		
" 7	Cattle	Butter 6 # @ 22¢	5	1.32		
" 9	Food & Fuel	Flour	15		12.	
" 9	Cattle	Butter 5 # @ 22¢	5	1.10		
" 11	Family Expenses	Sub. to Farmers Tribune	16		1.	
" 11	Family Expenses	Medicine	16		.10	
" 11	Farm Expenses	Clothes line 70¢ Tie rope 25¢	17		.95	
" 11	Cattle	Butter 5 # @ 22¢	5	1.10		
" 11	Cattle	Cream 4¾ qts. @ 20¢	5	.95		
" 12	Family Expenses	Lodge dues	16		1.	
" 13	Poultry	Oyster Shells	7		.25	
" 13	Clothing	Shoe repairing	14		.15	
" 13	Cattle	Butter 5 # @ 25¢ Cream 3 qts. @ 20¢	5	1.85		
" 16	Cattle	Butter 5 # @ 23¢	5	1.15		
" 17	Mach'y & Imp.	Sleigh repairs 50¢ Saw filing 60¢	8		1.10	
" 17	Cattle	Oil meal	5		1.65	
" 17	Ground Feed	Grinding	19		.60	
" 17	Family Expenses	Postal cards	16		.24	
" 17	Oats	95 bu. @ 35¢	9	33.25		
" 18	Clothing	Stockings	14		.25	
" 18	Family Expenses	Degree of Honor	16		2.	
" 18	Barley	11 bu. @ 42¾¢	10	4.70		
" 19	Food & Fuel	Wood	15		4.50	
" 20	Food & Fuel	Wood	15		4.50	
" 20	Family Expenses	Medicine	16		.15	
" 20	Cattle	Cream 1 gal.	5	.80		
" 21	Family Expenses	Sub. to American Boy	16		1.	
" 21	Poultry	Eggs 5 doz. @ 25¢	7	1.25		
" 22	Poultry	Eggs 4 doz. @ 25¢	7	1.		
" 22	Family Expenses	Medicine 55¢ Laundry 5¢	16		.60	
" 22	Food & Fuel	Lemons	15		.10	
" 27	Family Expenses	Medicine	16		2.	
" 27	Cattle	Cream 1¼ qts. @ 20¢	5	.25		
" 28	Family Expenses	Bks. & Stationery 75¢ Medicine 25¢	16		1.	
" 29	Oats	10 bu. 18 # @ 33½¢	9	3.54		
" 29	Corn	2 bu. 8 # @ 52¢	11	1.10		
" 29	Hay	303 # @ 6.40 per T	12	.81		
" 29	Food & Fuel	Board	15	11.50		
" 29	Poultry	Eggs 4 Doz. @ 25¢	7	1.		

151. Horse and Other Accounts

HORSE ACCOUNT — No. 4

Date	Title	Explanation	Post to No.	Debits	Credits	Balance
Feb. 1	Balance			$460.		
" 29	Man Labor	Feb. Labor Report		6.66		
" 29	Team Labor	Team Labor Report			$1.94	
" 29	Feeds	Feb. Feed Report		28.73		

HOG ACCOUNT — No. 6

Date	Title	Explanation	Post to No.	Debits	Credits	Balance
Feb. 1	Balance			$203.20		
" 29	Man Labor	Man Labor Report		2.50		
" 29	Feed	Feed Report		33.24		

POULTRY ACCOUNT — No. 7

Date	Title	Explanation	Post to No.	Debits	Credits	Balance
Feb. 1	Balance			$30.		
" 13	Cash	Oyster shells	3	.25		
" 21	Cash	Eggs 5 doz. @ 25¢	3		$1.25	
" 22	Cash	Eggs 4 doz. @ 25¢	3		1.	
" 29	Cash	Eggs 4 doz. @ 25¢	3		1.	
" 29	Man Labor	Feb. Labor Report		1.34		
" 29	Food & Fuel	Feb. Food Report	15		2.98	
" 29	Feed	Feb. Food Report		5.		

MACHINERY & IMPLEMENT ACCOUNT — No. 8

Date	Title	Explanation	Post to No.	Debits	Credits	Balance
Feb. 1	Balance			$447.25		
" 17	Cash	Sleigh repairs 50¢ Saw filing 60¢		1.10		

BARLEY ACCOUNT — No. 10

Date	Title	Explanation	Post to No.	Debits	Credits	Balance
Feb. 1	Balance			$72.70		
" 18	Cash	11 bu. @ 42¾¢	3		$4.70	
" 29	Ground Feed	24.18 bu. @ 36¢	19		8.71	

1. What was the expense on the horses for the month of February? What was the income from them?

2. What was the total loss on the horses in February?

3. What was the expenditures on the hogs at the close of February?

4. What were the expenses on the chickens for February?

5. What was the income on the chickens for the same time?

6. What was the balance for the chickens March 1?

7. What was the total expenditure on machinery to March 1?

8. What was the balance on barley March 1?

152. Cattle Account

CATTLE ACCOUNT

Date	Title	Explanation	Post to No.	Debits	Credits	Balance
Feb. 1	Balance			$486.		
" 3	Cash	Cream 80¢ 4½ # butter $1.00	3		$1.80	
" 5	Cash	Cream 5½ qts. @ 20¢	3		1.10	
" 7	Cash	6 # butter @ 22¢	3		1.32	
" 9	Cash	5 # butter @ 22¢	3		1.10	
" 11	Cash	5 # butter @ 22¢ Cream 95¢	3		2.05	
" 12	Mercantile Co.	Butter 5 # @ 22¢	18		1.10	
" 13	Cash	Butter 5 # @ 25¢ Cream 60¢	3		1.85	
" 13	Family Expenses	Butter 11½ # @ 22¢	16		2.53	
" 16	Cash	Butter 5 # @ 23¢	3		1.15	
" 16	Mercantile Co.	Butter 16¼ # @ 20¢	18		3.25	
" 17	Cash	Oil meal	3	1.65		
" 18	Mercantile Co.	Butter 10 # @ 22¢	18		2.20	
" 20	Cash	Cream 1 gal.	3		.80	
" 24	Mercantile Co.	Butter 10 # @ 22¢	18		2.20	
" 24	Mrs. Bixby	Butter 5 # @ 22¢	25		1.10	
" 27	Mercantile Co.	Butter 10 # @ 22¢	18		2.20	
" 27	Cash	Cream 1¼ qts. @ 20¢	3		.25	
" 29	Man Labor	Feb. Labor		14.98		
" 29	Food & Fuel	Milk, Cream, Butter used			11.79	
" 29	Feed	Feb. Feed		48.62		
" 29	Feed	Skim milk to calves			2.48	
" 29	Feed	Skim milk to hogs			3.65	

1. What was the balance on the cattle on the Hibbard Farm on February 1?

2. What was the expense of the cattle for the entire month?

3. What was the income from the cattle for the entire month?

4. What was the balance for the cattle on March 1?

5. What per cent of the cost of keeping the cattle for the month of February was the income?

153. Oats and Hay Account

OATS ACCOUNT No. 9

Date	Title	Explanation	Post to No.	Debits	Credits	Balance
Feb. 1	Balance			$512.72		
" 5	Cash	81 bu. 8# @ 35¢ per bu.	3		$28.44	
" 17	Cash	95 bu. @ 35¢	3		33.25	
" 29	Cash	10 bu. 18 # @ 33⅓¢	3		3.54	
" 29	Man Labor	Feb. Labor Report		.57		
" 29	Team Labor	Team Labor Report		.34		
" 29	Ground Feed	25.36 bu. @ 36¢	19		9.13	
" 29	Feed to cattle	Feb. Feed Report			.65	
" 29	Feed to horses	Feb. Feed Report			15.01	
" 29	Feed to poultry	Feb. Feed Report			3.59	

CORN ACCOUNT No. 11

Date	Title	Explanation	Post to No.	Debits	Credits	Balance
Feb. 1	Balance			$184.20		
" 29	Cash	2 bu. 8 # @ 52¢	3		$1.10	
" 29	Feed to horses	Feb. Feed Report			1.54	
" 29	Feed to cattle	Feb. Feed Report			11.96	
" 29	Feed to hogs	Feb. Feed Report			29.59	
" 29	Feed to poultry	Feb. Feed Report			1.41	

HAY ACCOUNT No. 12

Date	Title	Explanation	Post to No.	Debits	Credits	Balance
Feb. 1	Balance			$274.48		
" 29	Cash	303 # @ $6.00 per ton	3		$.91	
" 29	Feed to cattle	Feb. Feed Report			13.20	
" 29	Feed to horses	Feb. Feed Report			12.18	

CLOTHING ACCOUNT No. 14

Date	Title	Explanation	Post to No.	Debits	Credits	Balance
Feb. 1	Balance			$135.		
" 12	Mercantile Co.	Overalls	18	.50		
" 13	Cash	Shoe Repairs	3	.15		
" 18	Cash	Stockings	3	.25		
" 19	Mercantile Co.	Cloth & Ribbons	18	1.43		

HOUSE FURNISHINGS ACCOUNT No. 13

Date	Title	Explanation	Post to No.	Debits	Credits	Balance
Feb. 1	Balance			$488.		
" 18	Mercantile Co.	Broom	18	.35		

1. How much had the oats cost by the close of February?

2. How much had been received from the oats by the close of February?

3. What was the oats balance March 1?

4. How many bushels of corn were in stock February 1? (See inventory.)

5. What was the credit due the corn for February?

6. What was the corn balance March 1?

7. What was the investment in hay February 1?

8. For how much was hay credited in February?

9. Give the balance for hay March 1?

10. What was the balance for clothing March 1?

11. What was the investment in furnishings at the close of February?

154. Food and Fuel Account

FOOD AND FUEL ACCOUNT No. 15

Date	Title	Explanation	Post to No.	Debits	Credits	Balance
Feb. 1	Balance			$82.40		
" 5	Cash	Wood $8 Kerosene 15¢	3	8.15		
" 5	Mercantile Co.	Groceries	18	.50		
" 9	Cash	Flour	3	12.		
" 9	Mercantile Co.	Sugar	18	1.		
" 12	Mercantile Co.	Groceries	18	.40		
" 17	Mercantile Co.	Groceries $1.90 Chimney 10¢	18	2.		
" 19	Cash	Wood	3	4.50		
" 20	Mercantile Co.	Kerosene & Oranges	18	.54		
" 22	Cash	Lemons	3	.10		
" 24	Mercantile Co.	Crackers	18	.60		
" 27	Mercantile Co.	Sorghum & Sugar	18	1.50		
" 29	Cash	Board			$11.50	
" 29	Man Labor	Feb. Labor		1.21		
" 29	Team Labor	Feb. Team Labor		.80		
" 29	Man Labor	Board for man			10.35	
" 29	Cattle	Dairy produce used		11.79		
" 29	Poultry	Poultry & eggs used		2.98		

1. How much was given for food and fuel in February?

2. For how much were food and fuel debited for February?

3. What was the balance on food and fuel March 1?

155. Ground Feed and Other Accounts

GROUND FEED ACCOUNT No. 19

Date	Title	Explanation	Post to No.	Debits	Credits	Balance
Feb. 17	Cash	Grinding	3	$.60		
" 29	Man Labor	Feb. Labor Report		1.09		
" 29	Team Labor	Feb. Team Report		.80		
" 29	Oats	25.36 bu. @ 36¢		9.13		
" 29	Barley	24.18 bu. @ 36¢		8.71		
" 29	Feed to cattle				$20.33	

MRS. GREASON ACCOUNT No. 20

Feb. 1	Balance	Due F. C. Hibbard		$1.		

CRESCENT CREAMERY CO. ACCOUNT No. 21

Feb. 1	Balance	Due F. C. Hibbard		$8.40		

SCHOOL DISTRICT NO. 78 No. 22

Feb. 1	Balance	Due F. C. Hibbard		$.16		

MRS. SHERPY ACCOUNT No. 23

Feb. 1	Balance	Due F. C. Hibbard		$1.		

MRS. DUNLAP ACCOUNT No. 24

Feb. 1	Balance	Due F. C. Hibbard		$.40		

1. How much was expended on ground feed during the month of February?

2. For how much was ground feed credited for February?

3. How much was expended on the other accounts in February?

FAMILY EXPENSE ACCOUNT No. 16

Date	Title	Explanation	Post to No.	Debits	Credits	Balance
Feb. 5	Cash	Medicine 50¢ Stationery 27¢	3	$.77		
" 11	Cash	Sub. to Farmers Tribune	3	1.		
" 11	Cash	Medicine	3	.10		
" 13	Cattle	Butter given away	5	2.53		
" 12	Cash	Lodge Dues	3	1.		
" 17	Cash	Postal Cards	3	.24		
" 18	Cash	Degree of Honor	3	2.		
" 20	Cash	Medicine	3	.15		
" 22	Cash	Medicine 55¢ Candy 5¢	3	.60		
" 21	Cash	Sub. to Amer. Boy	3	1.		
" 27	Cash	Medicine	3	2.		
" 28	Cash	Bks. & Stationery 75¢ Medicine 27¢	3	1.		

FARM EXPENSE ACCOUNT No. 17

Feb. 5	Cash	Personal property tax	3	$6.51		
" 5	Cash	Binder twine	3	22.50		
" 11	Cash	Clothes line 10¢ Tie rope 25¢	3	.95		

MERCANTILE CO. ACCOUNT No. 18

Feb. 1	Balance	Due F. C. Hibbard		$1.01		
" 5	Food & Fuel	Groceries	15		$.50	
" 9	Food & Fuel	Sugar	15		1.	
" 12	Food & Fuel	Groceries	15		.40	
" 12	Clothing	Overalls	14		.50	
" 12	Cattle	Butter 5 # @ 22¢	5	1.10		
" 16	Cattle	Butter 16¼ # @ 22¢	5	3.25		
" 17	Food & Fuel	Groceries $1.90 Chimney 10¢	15		2.	
" 18	House Fgs.	Broom	13		.35	
" 18	Cattle	Butter 10 # @ 22¢	5	2.20		
" 19	Food & Fuel	Crackers	15		.25	
" 19	Clothing	Cloth & Ribbons	14		1.43	
" 20	Food & Fuel	Kerosene & Oranges	15		.54	
" 24	Cattle	Butter 10 # @ 22¢	5	2.20		
" 24	Food & Fuel	Crackers	15		.60	
" 27	Food & Fuel	Sorghum & Sugar	15		1.50	
" 27	Cattle	Butter 10 # @ 22¢		2.20		

4. How much cash did the family spend during the month of February?

5. What were the farm expenses for the month of February?

6. Balance Mr. Hibbard's account with the mercantile company March 1.

Optional Problem

7. What per cent of the farm property was real estate?

MEANING OF WORDS PECULIAR TO RURAL ARITHMETIC

Apple blotch. A fungous disease which attacks the skins of apples.

Basic slag. A compound of phosphorus and other materials resulting from the smelting of iron.

Beet pulp. Solid matter of sugar beets after the sugar is taken out.

Bordeaux mixture. A mixture of lime and copper sulphate for destroying the fungous diseases of plants.

Bran. The seed coat of the wheat grain which has been separated from the rest of the grain.

Broadcasting. Scattering seed over the ground, originally with the hand.

Casein. The protein in milk.

Calorie. Unit for measuring heat.

Caustic lime. Unslaked lime.

Codlin moth. A small moth, the larva of which is a small worm that attacks apples.

Concrete 1 : $2\frac{1}{2}$: 5 mixture. A mixture of 1 part of cement, $2\frac{1}{2}$ parts of sand, and 5 parts of stone or gravel.

Concrete 1 : 2 : 4 mixture. A mixture of 1 part of cement, 2 parts of sand, and 4 parts of stone or gravel.

Corn stover. Corn fodder with the ears of corn removed.

Curculio. An insect which attacks plums and peaches.

Depreciation. A lessening in value, due to use or deterioration.

Double disked. Cultivated twice with a disk harrow.

Dredge. A machine used in digging ditches.

Drilled. Seed planted in the ground by means of a drill.

Dwarf fruit. A small variety of fruit trees caused by pruning roots and tops or by the selection of small varieties.

Experiment Station. A farm where experiments in agriculture are carried on.

F.O.B. Free on board cars at the station named.

Glaciated. Land formed by glacial action.

Gluten meal. A by-product of corn or wheat rich in protein.

Gluten feed. A by-product of corn or wheat, which is not so concentrated as gluten meal.

Hominy feed. A by-product resulting from the manufacture of hominy.

Kafir corn. A dry-climate corn, the grain of which is grown on the tassel. It is of the same family as sorghum.

Kainite. A mineral rich in potassium. It is extensively used as a fertilizer.

Lactation period. The length of time a cow produces milk.

Legume. A member of the family of plants that support the bacteria which take nitrogen from the air and change it to available plant food. The bean is a common member of this family.

Lime sulphur. A spray material composed of lime and sulphur and used in destroying fungous diseases and scale insects.

Linseed meal. Flax seed from which the oil has been removed.

Listed. The operation of planting corn with a lister instead of a planter. A common method of planting corn in arid regions.

Loam. A soil rich in organic matter and sand.

Lower Illinoisan. An area of southern Illinois, which was formed by a glaciation period called the Lower Illinoisan Glaciation.

Malt sprouts. Sprouts from grain sprouted in the process of producing malt liquors, particularly beer.

Middlings. Coarse flour which cannot be made fine enough for table use. It usually contains some bran.

Modeling-clay. Clay used in schools for modeling various figures.

Nutrients. Portions of feeds which support the animal body.

Oil-cake. Linseed meal in the form of cakes or large flakes.

Rag-doll tester. Seed tester consisting of a piece of cloth marked in squares on which seeds are placed for germination.

Rotation. The following of one crop with another one of a different kind.

Roughage. A bulky feed such as hay, silage, or fodder.

Scab. A fungous disease which attacks fruit.

Scratch feed. Feed of small dimensions given to chickens to cause them to scratch.

Silt. Soil of very fine particles usually deposited by water.

Surface soil. The 7 inches of top soil rich in plant food.

Unglaciated. Soil which has never been covered by glaciers.

Water-slaked lime. Lime which has been slaked by means of water.

ANSWERS

NOTE: The page references in connection with Section numbers indicate the pages of *A Rural Arithmetic* on which the section itself begins. Occasionally the problems will begin on the following page.

Section 4, page 4

1. 121,219 lb. 2. 63,400 lb. 3. $17.26
4. 215,835,800 A.; 5,537,863,000 bu. 5. 2,430,270,000 bu. 6. 64,797,000 A.
7. 219,051,000 8. 9,244,000
9. 1336 lb. 10. 2319 lb. 11. $2253
12. [1] 30,556 [2] 30,894 [3] 39,148 [4] 24,079
[5] 36,939 [6] 45,233 [7] 45,695 [8] 41,705

Section 5, page 8

1. 4299 2. 6045 3. 4786 4. 5340 5. 4109
6. 4967 7. 5615 8. 5086 9. 5203 10. 4688
11. 4977 12. 4517 13. 4224 14. 5120 15. 4217
16. 4941 17. 4128 18. 5129 19. 5479 20. 4801
21. 5447 22. 4533 23. 4471 24. 3807

Section 6, page 9

1. [1] 242 [2] 339 [3] 97 [4] 1083 [5] 5158
[6] 2229 [7] 172 [8] 6537 [9] 1228 [10] 3529
2. 6521
3. [1] 338 [2] 345 [3] 345 [4] 315 [5] 296 [6] 347 [7] 325 [8] 365
4. [1] 68,138 [2] 18,035 [3] 5107 [4] 71,349
[5] 141 [6] 239 [7] 1889 [8] 60,181

Section 7, page 10

1. [1] 24,685,390 [2] 27,403,168 [3] 89,174,059 [4] 26,673,751
[5] 52,084,319 [6] 34,276,915 [7] 60,380,584 [8] 27,180,297
[9] 94,085,361 [10] 12,465,937 [11] 51,386,394 [12] 42,070,968
[13] 14,039,751 [14] 75,096,431 [15] 67,082,214 [16] 85,915,923
[17] 76,886,034 [18] 39,210,475 [19] 34,588,012 [20] 72,069,314
[21] 97,816,325 [22] 96,074,105 [23] 56,793,382 [24] 14,892,635

Section 8, page 11

3. $992.00 4. 168,000 lb. 5. $23.52
6. $80.60 7. $10.30 8. $16.34; $147.06
12. $12.00 13. $54.00 14. $105.00
15. $668.80 16. 2,340,000 lb. 17. 40,480 lb.
18. [1] 8,644,428 [2] 42,539,745 [3] 17,435,768 [4] 11,913,036
[5] 44,721,972 [6] 3,592,545,282 [7] 20,743,680 [8] 15,056,104
[9] 8,805,176 [10] 9,878,806 [11] 156,614,094 [12] 55,445,670

Section 9, page 14

1. 231,252 2. 322,431 3. 380,234 4. 134,373 5. 483,340
6. 206,271 7. 4,790,020 8. 477,624 9. 1,778,192 10. 368,714
11. 310,460 12. 397,985 13. 588,596 14. 90,668 15. 574,955
16. 295,301 17. 4,840,872 18. 274,855 19. 3,054,120 20. 287,777
21. 278,616 22. 727,059 23. 487,422 24. 132,475 25. 94,335
26. 239,134 27. 262,581 28. 487,815 29. 243,616 30. 877,404
31. 157,916 32. 4,859,520 33. 372,824 34. 1,772,541 35. 185,661

Section 10, page 15

1. 2114.38 lb.; 30.21 bu. 2. 123 lb. 3. 18 da.
4. 1128 lb. 5. 47.41 lb.
6. [1] 341 [2] 456 [3] 5621 [4] 671 [5] 142 [6] 1376.85
[7] 24 [8] 121 [9] 124 [10] 347 [11] 842 [12] 436
7. 5115.15 lb.

Section 11, page 16

3. 2 doz.; 40.5¢ 4. 1200 lb. 5. 3240 qt. 6. 437.09 bu.; $271.00

Section 12, page 17

1. 291 2. 904 3. 290 4. 941 5. 806 6. 421
7. 420 8. 861 9. 451 10. 703 11. 730 12. 450
13. 681 14. 680 15. 1031.48 16. 571 17. 851 18. 906
19. 850 20. 961 21. 741 22. 740 23. 302 24. 321

Section 13, page 17

1. 300 lb.; 300 lb.; 900 lb.
2. 3 da.; 30 lb. grain; 30 lb. hay; 90 lb. silage
3. 200 lb. bran; 400 lb. mids.; 400 lb. corn meal; 600 lb. ground oats; 500 lb. beef scrap; 10 lb. salt.

4. $900 6. 57,477 lb. 7. 6762 gal. 8. $2704.80

9. [1] $270.02 [2] $320.85 [3] $299.34 [4] $143.15 [5] $363.25
[6] $259.76 [7] $212.19 [8] $348.56 [9] $208.66 [10] $279.01

10. $932.60 11. $594.97 12. $337.63 13. $33.76

14. 3271.56 lb. 15. 34.8¢ 16. 28.54¢

17. 5702.8 lb. Jerseys; 5792.6 lb. Guernseys

18. 4.75 lb. Jerseys; 4.54 lb. Guernseys

19. $92.40 Jerseys; $94.12 Guernseys

20. 1666.84 lb. Jerseys; 1604.72 lb. Guernseys

21. Jerseys $666.74; $133.35; Guernseys $641.89; $128.38

22. $277.63 23. 31 bu.; 8 bu. 24. 10.4 bu.; 2.7 bu. 25. 327.5 bu.

26. $2173.80; $1953.20 27. 61 bu.; 49.11 bu.; 11.89 bu.

28. 38.77 bu. 29. 31.33 bu.; 28.7 bu.

Section 14, page 22

1. 5280 ft. 2. 1760 yd. 3. 321 posts 4. 4 rd. 5. $147.20
6. 149 rd., 15.84 ft. 7. 635 rd., 25 ft. 8. $491.38 9. $94.20

Section 15, page 23

2. 816 grains 4. 4 rd.; 8 rd. 5. 80 rd. 6. 2 rd. 7. 5 A. 8. 84 A.

Section 16, page 25

3. 150 cu. ft. 4. 1122.07 gal. 5. 385.69 bu.
6. 60.26 bu. 7. 64 cu. yd. 8. 9112.5 ft.

Section 17, page 26

1. $22.00 2. $7.50 3. $45 4. 33 lb., 13 oz.
5. $7.44 6. 40 T. 7. 2.4¢ 8. 4.6¢

Section 18, page 27

1. 9.66\frac{2}{3}$ 2. 26.5 gal. 3. 26¢ 4. 598.44 gal.

Section 19, page 28

1. 33$\frac{1}{3}$ crates; 25 bu. 2. 12$\frac{1}{2}$¢ 3. $2000 4. 5$\frac{5}{8}$¢
5. 8640 qt.; 270 bu.; 13.5¢; $4.33 6. 40.64 bu. 7. 52.58 8. 714.28 bu.

Section 20, page 29

1. 50 gr. 2. $15.00 3. $72.00 4. $1.14 5. 2¢ 6. $360.00 7. $216.00

Section 21, page 29

2. \$3.62 3. 13 sheets 4. 50¢ 5. \$72 6. \$13.20

Section 24, page 32

2. $1\frac{1}{3}$ lb. 3. $236\frac{17}{24}$ 4. $1\frac{249}{400}$ in. 5. [1] $1\frac{5}{6}$; [2] $\frac{157}{168}$; [3] $\frac{47}{96}$; [4] $1\frac{23}{56}$ [5] 1 [6] $\frac{59}{72}$

Section 25, page 34

9. $547\frac{7}{24}$ sq. ft. 10. $3694\frac{23}{28}$ sq. rd. 11. $28\frac{1}{2}$ ft. 12. \$5.25

Section 27, page 36.

7. \$1525.43 8. \$1422 9. 8 strips 10. 44¢
11. \$7.75 12. $15\frac{5}{8}$ in. 13. 80 boards

Section 29, page 39

1. 618.672 2. 99.67 3. 375.364 4. 5210.51 5. 108.171
6. 3699.615 7. 3853.383 8. 515.765 9. 1437.07 10. 4174.4393
11. 8679.3781 12. 1052.119 13. 1275.196 14. 412.594 15. 6715.7904
16. 2.2206 17. 495.95 lb.

Section 30, page 40

1. 7.6041 2. 6.7872 3. 395.6 4. 14,874.8 5. 1379.84
6. 8711.82 7. 276.72 8. 1621.2 9. 4.3704 10. 5898.2
11. 3577.672 12. 4534.5932 13. \$96 14. \$861 15. \$3489.36
16. \$295.20 17. \$77.62 18. \$2637.13

Section 31, page 41

4. 15.3 eggs 5. .74¢ 6. .93¢; 6.5¢

Section 32, page 42

1. 10; .1; 1000; .001 2. 5.8525 3. .5 4. 89.23
5. 362 6. 3640 7. 122,400 8. 36.21
9. 142.1 10. 36.24 11. 5621 12. 261
13. 4263.1 14. 423.1 15. 34.21 16. 426.1
17. 3412 18. 3412 19. \$2018.925 20. 150 pieces
21. 211.87 bu. 22. 9.7¢ 23. \$85.36 24. 81.4¢

Section 33, page 43

12. $\frac{1}{10}$; 10% 13. \$9.00 14. 10% 15. \$2.50
16. $\frac{1}{10}$; 90%; \$1.80; \$16.20 17. \$100; $\frac{1}{2}$; 50% 18. \$100.00

Section 34, page 46

4. \$12
5. 6%
6. \$200

Section 35, page 47

1. 1.6 lb.; $\frac{1}{25}$
2. 1.2 lb.; 1.44 lb.; 1.5 lb.
3. 289.08 lb.
4. \$18.61
5. \$30
6. 26,790 lb.
7. \$714
8. 221.03 lb.
9. .6 lb.; 35¢

Section 36, page 48

1. $\frac{1}{10}$
4. $\frac{1}{4}$
5. 40%
6. 50%; 400 lb.; $\frac{1}{2}$
7. 10%
8. $14\frac{2}{7}$%
9. 24 bu.; 34 bu.; $33\frac{1}{3}$%; $14\frac{12}{17}$
10. 5%; $7\frac{1}{2}$%
11. $60\frac{3}{7}$%
12. 20%
13. 42¢
14. $2\frac{1}{2}$%
15. 62.5%
16. 1.317%
17. .777%
18. 1.197%
19. \$1513.90; 7.98¢
20. 16¢

Section 37, page 51

3. \$12,000; \$80.00
4. \$24,800
5. \$16,800
6. \$6.50; \$108.33
7. \$3100
8. 25%
9. \$165
10. 8%; 3.6%
11. 6800 bu.
12. 962.8 lb.
13. 27,746.4

Section 38, page 52

3. 6.25%
4. 127.27%
5. 20%
6. 63.63%
7. \$1
8. 82.85%
9. 72%
10. $71\frac{1}{4}$%
11. 71%
12. \$1.20
13. 22%
14. \$276
15. \$88
16. 16 shares
17. \$81.25

Section 39, page 54

1. \$160
2. \$30; \$30; \$24; \$6
3. \$565.51
4. \$25.98
5. \$25.60
6. \$75.00
7. 5.3%
8. \$1151.04
9. \$1303.20
10. \$163.50
11. \$196.96
12. \$850
13. \$576

Section 40, page 57

1. Corn 29.5¢; Wheat 54.8; Oats 32.5¢
2. Clover \$4.18; Alfalfa \$3.10
3. 17¢
4. 12.58¢; \$2.59
5. \$4.75
6. \$41.28
7. 35.6¢
8. \$3044.40
9. \$1392.22

Section 41, page 58

1. 10.5 bu. wheat; 9.175 bu. barley; 31.375 bu. oats; 26.075 bu. emmer; 14.6 bu. wheat
2. 16.275 bu. wheat; 16.525 bu. barley; 39.875 bu. oats; 37.5 bu. emmer; 14.25 bu. wheat

3. 8.5 bu. 4. 240 bu. 5. 12 bu.; 1.5 bu.; 5.6 bu. 6. 6.266 bu.
7. 752 bu. 8. $270.72 9. 324 bu.; $116.64 10. 288 bu.

Section 42, page 60

1. 50¢ favoring oat stubble 2. 17.55 bu. favoring oat stubble
3. 4.461 bu. favoring wheat stubble; 8.12 bu. favoring oat stubble
4. $3.61 (3 in. deep); $4.19 (7 in. deep)
5. 14¢ 6. 15¢ 7. $18.57; $17.38

Section 43, page 62

1. $11.12; $12.02 2. $11.57 3. 29.4¢ 4. $7404.80 5. $4975.36
6. $4103.68 7. $6722.56 8. 30.4¢ 9. 34.4¢ 10. 22.7¢

Section 44, page 64

1. $12.01; $12.31; $12.16 2. 96¢

Section 45, page 65

1. 33¢; 32¢ 2. 56¢ 3. $2.95 4. 58¢ 5. 58¢
6. $22,412.80 7. $30,864

Section 46, page 66

1. Clover $8.538; alfalfa $11.33; wild hay $6.722
2. Wild hay $2.797; clover $3.256; alfalfa $5,134
3. Clover 61.8%; wild hay 58.3%; alfalfa 54.6%
4. Wild hay $5.38; clover $2.90; alfalfa $3.40
5. Alfalfa $34.48

Section 47, page 67

3. $46.02 4. 15.027 bu.; 2.22 tons 5. $51 6. 35.29%; 64.71

Section 48, page 69

1. 244.2 lb. nitrogen 2. 1848 lb. nitrogen 3. 90 lb. nitrogen
4. 1653 lb. nitrogen 5. 135 lb. nitrogen 6. 80 lb. nitrogen
7. 2.6 lb. nitrogen 8. 32.67 lb. nitrogen 9. 5200 lb. nitrogen
10. 19 lb. loss, nitrogen 11. 16.90 lb. gain, nitrogen 12. 23.22 lb. gain
13. 407.52 lb. nitrogen

Section 49, page 71

1. 37.28 bu. 2. 112.66% 3. 372.8 lb. nitrogen 4. 474.85 lb. nitrogen
5. Corn 76.29; oats 43.65; clover 93.47 6. 9.32 T.

Section 50, page 73

1. 6.8 lb. phosphorus
2. 9.2 lb. phosphorus
3. 7.2 lb. phosphorus
4. 40 lb. phosphorus
5. 92 lb. steamed bone meal
6. 250.88 lb. rock phosphate
7. 8.04 tons manure
8. 265 lb. N. lost; 340 lb. P. gained
9. 120.25 gain, P.
10. Raw rock $13.13; acid phosphate $26.25
11. 3¢ per lb.
12. 407 lb. potassium
13. 7.6 lb. potassium
14. 192.24 lb. potassium chloride
15. 253.41 lb. potassium chloride
16. 1.71¢
17. 4.26¢ corn; 6.96¢ wheat; 4.08¢ oats

Section 51, page 75

1. Caustic lime from stone 32 bu. corn; 10.67 bu. wheat; .77 tons clover
   Caustic lime from shells 32.25 bu. corn; 11.34 bu. wheat; .71 tons clover
2. 37 bu. corn; 14 bu. wheat; .9925 tons clover
3. 7.5 bu. for burned stone; 7.75 bu. for burned shells
4. 3⅛ bu. for burned stone; 3⅔ bu. for burned shells
5. 7.5 bu. corn; no wheat; .1225 tons hay
6. 1120 lb. quick lime; 1480 lb. water-slaked lime
7. $2.68 quick lime; $2.03 water-slaked lime
8. $1.79 quick lime; $1.35 water-slaked lime

Section 52, page 77

1. 2.08 lb. nitrogen
2. .5 lb. nitrogen
3. 41.7¢
4. 28.85 lb. nitrogen
5. 21.54 lb. nitrogen
6. 4.23 lb. phosphorus
7. 4.37 lb. phosphorus; 1.453 potassium
8. 2.59 tons clover
9. 182 lb. N.; 30.07 lb. P.; 146.3 lb. K.
10. 18.2 tons
11. 36.4 lb. phosphorus
12. 7 lb. kainite

Section 53, page 79

1. 1580 lb. nitrogen
2. 270 lb. phosphorus
3. 1200 lb. potassium
4. 13.17 lb. N.; 2.25 lb. phosphorus; 10 lb. potassium
5. 13.12 tons
6.

Horses	Cows	Pigs	Sheep	Hens
N.	N.	N.	N.	N.
.66	.59	.49	.79	1.0
P.	P.	P.	P.	P.
.11	.072	.15	.15	.35
K.	K.	K.	K.	K.
.5	.41	.38	.74	.33

7. 3078 lb. nitrogen; 378 lb. phosphorus; 2160 lb. potassium
8. 1580 lb. nitrogen; 270 lb. phosphorus; 1200 lb. potassium
9. 22.779 tons horse manure
10. 4.373 tons horse manure
11. 6¢ in kainite; 12¢ in wood ashes; 4.82¢ in potassium chloride; 5.64¢ in potassium sulphate
12. 83% potassium
13. 5.88¢ per lb.
14. 2.55% potassium
15. 5.24% phosphorus
16. 33.615 phosphoric acid

Section 54, page 81

1. 313 lb. nitrogen
2. 16.019¢ per lb.
3. 124 lb. phosphorus
4. 10.18¢ per lb.
5. 12.89¢ per lb. for phosphorus
6. 19.58% increase
7. 37.38¢
8. Sodium nitrate $80.50 per ton;
   Ammonium nitrate $466.67;
   Potassium chloride $182

Section 55, page 82

1. 128 lb. nitrogen; 115.2 lb. nitrogen; 140.8 lb. nitrogen
2. 150 lb. nitrogen
3. 89 lb. phosphorus
4. 13064.5 lb. N.; 2049.75 lb. P.; 8901.75 lb. K.
5. 137.2 lb. nitrogen; 00 lb. P.; 103.6 lb. K.
6. $48.50
7. $62.00
8. 9.22 lb. of nitrogen
9. 7 lb. N.; 4⅔ bu. corn
10. 6.09 bu. corn
11. $430,899,200
12. $11,992,800 for P.; $89,420,000 K.
13. $83,449,520 for plant food
14. $58,414,664 lost
15. 9,696,894,480 lb. N.; 1,343,761,388 lb. P.; 6,661,809,000 lb. K.
16. 6,464,596,320 bu. corn
17. 4,525,217,424 bu corn
18. $1,924,906,408.44

Section 56, page 85

1. 6300 lb. N. left
2. 1318 lb. P. left
3. 490 lb. more P. in black clay loam
4. 240 lb. more P. in yellow silt loam
5. 32.2 lb. N. needed
6. 3,920 lb. rock phosphate needed

Section 57, page 87

1. 3,125,713,000 lb. nitrogen
2. 166,906,320 lb.
3. Corn 27.42 bu.; wheat 14.13 bu.; oats 31.93 bu.
4. 21.71 lb. potassium
5. Corn $13.71; wheat $12.72; oats $11.18

Section 58, page 88

1. $217.14
2. $46.25 Sodium nitrate; $9.15 Acid phosphate; $38.24 muriate of potash
3. $352.90 4. $10.58 5. $25.34 6. $840

Section 59, page 89

1. 40 lb. N.; 160 lb. phosphoric acid; 120 lb. potash
2. $18.80 per ton
3. 80 lb. nitrogen; 160 lb. phosphoric acid; 140 lb. potash 4. $7.40
5. 559.36 rock phosphate; 1162 kainite; 278.64 sand
6. 195.29 lb. potassium sulphate; sand 959.73 lb.; 489.44 steamed bone meal; 355.54 sodium nitrate
7. $22 8. $2.26

Section 60, page 91

1. $17.27 2. 1096.35 bu. corn 3. $383.69 4. $23.21 5. $14.30
6. 51¢ 7. $15.25 8. $39.60 9. $429 10. $544.50

Section 61, page 92

1. 185,309 lb. milk 2. 5977.7 lb. milk
3. [1] 246.734 lb.; [3] 273.523 lb.; [6] 378.231 lb.
4. 773.385 lb. butter-fat 5. $2963 6. $63.52
7. $1969 8. $994 9. $1922.23 10. $188.26
11. $35.92 12. $2146.41 13. $4115.41 14. $4339.47
15. 5.105¢ per quart 16. 1.62¢ per quart loss
17. $736 for 6 best; $386 for 6 poorest
18. Jerseys 6013.63 lb. milk; Guernseys 5920.83 lb. milk
19. Jerseys $98; Guernseys $91.75 20. Jerseys 4.67%; Guernseys 4.6%
21. $283.27 22. $6800.33 23. $4250.21 24. 10.5 months
25. 4 yr. 4.93%; 5 yr. 4.58%; 6 yr. 4.76%
26. 4 yr. $99.33; 5 yr. $99.20; 6 yr. $90.60
27. 1095.84 lb. butter 28. $382.75

Section 62, page 95

1. 12462.3 lb. difference 2. 1384.7 lb.
3. $186.93 4. $20.77 5. 6.63 lb. daily
6. Group 1. $226.33; Group 2. $203.36 7. $150.46 gain for Group 1
8. Group 1. .0326; Group 2. .0307 9. Group 1. 3.26%; Group 2. 3.07%
10. Group 1. 57.6¢; Group 2. 75.7¢ 11. Group 1. 5.02¢; Group 2. 6.6¢

Section 63, page 97

	P	C	F
1. Group 1.	7.12;	40.71;	3
2. Group 2.	5.99;	59.12;	3.03

3. 40.71 lb. carbohydrates
4. Group 1. 1:6.66; Group 2. 1:11

Section 64, page 98

1. 1:7.79 2. 1:7.37 3. 1:6.19 4. 1:6.54 5. 1:6.48 6. 1:5.88

Section 65, page 100

1. 6.61 lb. corn meal
2. 9.16 lb. corn and cob meal
3. 2.327 lb. corn meal
4. Excess .01 lb. protein
5. 2.39 lb. 6. 9.42 lb. 7. 7.14 lb. 8. 3.874 lb. 9. 9.21 lb.
10. 62.64 tons silage; 9.18 tons cotton seed meal
11. 16.11 lb.
14. 83,925 lb. milk; 2,542.5 lb. fat

Section 66, page 104

1. Ration 1, 5.023%; Ration 2, 4.973 %
2. Ration 1, 7.56 lb.; Ration 2, 6.51 lb.
3. 14% increase in milk; 16.13% increase in fat

Section 67, page 104

1. 7.95% increase
2. Ration 1, 100%; Ration 2, 111.43%
3. Ration 1, 4.29%; Ration 2, 5.17%

Section 68, page 104

1. Lot 1, $441.18; Lot 2, $444.68
2. $240.71 3. $284.28 4. $752.37 5. $26.91
6. $249.89 7. $295.31 8. $863.04 9. $123.05
10. Lot 1, $311.19; Lot 2, $418.36
11. Lot 1, $2.24; Lot 2, $10.25
12. Lot 2 gained 724.96 lb. more than lot 1; 264.83 lb. per steer
13. $1550.83 14. $1612.71 15. $909.19 16. $2521.90
17. $2426.52 18. $95.38 19. $2.81

Section 69, page 106

1. 6942 lb. 2. $100.70 3. $43.70 4. 404 lb.
5. $34.70 6. $11,181.30 7. $191.19 8. 109,980

Section 70, page 107

1. 1.07 lb. daily gain 2. \$6.85 3. 4.57¢ 4. .758 lb.
5. \$6.50 6. 6.12¢ 7. .403 lb. 8. \$3.54 9. 6.26¢
10. Lot 1, \$45.70; Lot 2, \$61.20; Lot 3, \$62.60
11. Lot 1 ration
12. \$227.57 13. \$440.36

Section 71, page 109

1. Lot 1, \$21.46; Lot 2, \$19.87; Lot 3, \$22.21; Lot 4, \$24.66; Lot 5, \$17.54
2. 1056.16 lb. 3. \$36.50
4. 1101.86 lb. 5. \$60.60
6. \$2.64 7. 1097.42 lb. 8. \$27.62
9. \$7.75 10. \$34.49 11. 1088.8 lb 12. \$11.38 13. \$5.91
14. \$34.93 15. 200.08 lb. 16. \$3.95 17. \$34.35
18. 1096.18 lb. 19. \$13.88
20. Lot 1, \$2.64; Lot 2, \$7.75; Lot 3, \$5.91; Lot 4, \$3.95; Lot 5, \$13.88
21. Dry matter, 30.117 lb.; protein, 6.21 lb.; carbohydrates, 10.243 lb.; fat, 1.165 lb. 22. 1:2.071 23. 322.79 lb. protein
24. 351.12 lb. protein 25. 7.216 lb. carbohydrates
26. 15.826 lb. dry matter 27. 7.53 lb. 28. 21.66 lb.

Section 72, page 111

1. 1245.11 lb. 2. \$317.50 3. 12,570.83 qt. 4. \$1257.08
5. 10.35 lb. salt 6. Creamery butter 35.29¢; Country butter 31.25¢
7. 1121.13 lb. 8. 33.63 lb.
9. 1133.2 lb. butter; \$1017.19 10. \$1271.48
11. 35.97¢ per pint 12. \$1.12 13. \$692.63 14. \$279.57
15. 4274.78 pints 16. 16¢ per pt. 17. \$391.74 18. 4.02% 19. 1045.5 lb.

Section 73, page 113

1. Ration 1, 26.9¢; Ration 2, 29.38¢; Ration 3, 30.35¢; Ration 4, 32.48¢
2. \$2371.04

Section 74, page 114

1. Period [1] 16.76 lb.; Period [2] 17.97 lb.; Period [3] 17.10 lb.
2. Cow No. 2; \$44.07 3. 7,455.9 lb. milk 4. 16.19 lb. daily
5. 16.19 lb. daily 6. .769 lb. fat; 8,168 fat 7. 39.84 lb. butter
8. .902 butter from stover; .961 lb. butter from hulls.
9. Protein 2.563 lb.; carbohydrates 6.728 lb.; fats .893 lb.
10. 1:3.409 11. 60.95 lb. butter

Section 75, page 116

1. Cow No. 36, 35.5 lb.; Cow No. 28, 11.95 lb.
2. Cow No. 36, 1.36 lb.; Cow No. 28, .54 lb.
3. Cow No. 36, $123.58; Cow 28, $43.09
4. $2.53 5. Lady 341.17 lb.; Kate 50.68 lb. fat.
6. 11.3¢, Lady; 61¢, Kate
7. Lady $79.57 profit; Kate $13.73 loss; Lady $2.06 profit; Kate $.44 loss
8. $137.31 9. $3089.50
10. 44,925 lb. milk; 1267 lb. fat 11. $3432.75

Section 76, page 117

1. [1] 769 lb. [2] 642 lb. [3] 723 lb. [4] 800 lb. [5] 713 lb.
2. [1] .7879 lb. [2] .6577 lb. [3] .7407 lb. [4] .8196 lb. [5] .7305 lb.
3. Lot 1, $49.78; Lot 2, $39.04; Lot 3, $39.84; Lot 4, $38.94; Lot 5, $40.15
4. Lot 1, 1177.34 lb.; Lot 2, 1058.15 lb.; Lot 3, 1138.58 lb.; Lot 4, 1212.22 lb.; Lot 5, 1127.92 lb.
5. Lot 1, $3.31; Lot 2, $2.97; Lot 3, $3.20; Lot 4, $3.41; Lot 5, $3.17
6. Lot 1, $53.09; Lot 2, $42.01; Lot 3, $43.04; Lot 4, $42.35; Lot 5, $43.32

Section 77, page 119

1. Lot 88. 1.375 lb.; Lot 89. 1.026 lb. 2. 89.4 days 3. 303.91 lb. corn 4. $4.28
5. 52.33% 6. $5.56 10. 71.69%
7. 3.534 lb. corn 8. $6.36 9. $8.15
11. $6.08 12. $15.39 13. Ration fed lot 88
14. Lot 88, $428; Lot 89, $636; Lot 90, $608

Section 78, page 120

1. Lot 72, 1.619 lb.; Lot 73, 1.69 lb.; Lot 86, 1.15 lb.; Lot 87, 1.428 lb.
2. $2.99 3. $2.80 4. Lot 73, 10.02%; Lot 86, 9.99%; Lot 87, 10%
5. Lot 72, 100%; Lot 73, 89.98%; Lot 87, 45%
6. 45% 7. $3.14 8. $3.08

Section 79, page 121

1. Ala. 9.56 lb.; Colo. 10.37 lb.; Ill. 11.2 lb.; Kan. 11.69 lb.; Ky. 9.54 lb. Mo. 11.62 lb.; Nebr. 10.57 lb.; W.Va. 9.68 lb.
2. 72.59¢ per bu. 3. 5.13¢ 4. $2.52
5. 4,968.75 bu. 6. 750 lb.; 1000 lb.

Section 80, page 122

1. Lot 68, 1.676 lb., Lot 69, 1.162 lb.; Lot 70, 1.888 lb.; Lot 71, 1.397 lb.
2. Lot 66, $2.53; Lot 68, $1.30; Lot 69, $.95; Lot 70, $1.42; Lot 71, $1.01
3. Lot 68, 11¢; Lot 69, 24¢; Lot 70, 18¢; Lot 71, 38¢
4. Lot 66, $4.49; Lot 68, $2.47; Lot 69, $3; Lot 70, $2.49; Lot 71, $2.92
5. $194.22
6. 11.91 bu.

Section 81, page 123

1. Lot 3, 3.946 lb.; Lot 1, 3.712 lb.
2. Lot 3, 76.9 lb.; Lot 1, 58.6 lb.
3. Lot 3, .64 lb. Lot 1, .49 lb.
4. Lot 3, shorts 205.52 lb.; hominy 411.04 lb.; shorts 252.52 lb.; corn meal 505.03 lb.
5. Lot 3, $7.71; Lot 1, $8.48
6. Lot 3, $9.25; Lot 1, $9.25
7. Lot 19, 5.445 lb.; Lot 20, 5.855 lb.
8. Lot 19, tankage 51.95 lb.; hominy 1,039. 05 lb. Lot 20, tankage 55.76 lb.; corn meal 1,115.24 lb.
9. Lot 19, 1.11 lb.; Lot 20, 1.385 lb.
10. Lot 19, 4.91 lb.; Lot 20, 4.23 lb.
11. Lot 19, $6.37; Lot 20, $4.72

Section 82, page 125

1. Lot 1, 111.33 lb.; Lot 2, 89.1 lb.; Lot 3, 55.166 lb.; Lot 4, 88.6 lb.; Lot 5, 98.66 lb.
2. Lot 1, 1.795 lb.; Lot 2, 1.437 lb.; Lot 3, .889 lb.; Lot 4, 1.429 lb.; Lot 5, 1.591 lb.
3. Lot 3, $5.36; Lot 5, $4.05
4. Lot 3, 10.45 lb.
5. Lot 5, 14.44 lb.
6. Dry matter 793.25 lb.; protein 69.209 lb.; carbohydrates 592.716 lb.; fat 38.1539 lb.
7. 1:9.8

Section 83, page 126

1. Nutritive ratios, 3.98; 4.96; 6; 6.918; 7.5
2. Nutritive ratios, 3.98; 4.98; 5.5; 5.944; 6.325

Section 84, page 127

1. 1.9 lb.; 26 lb.; 2.8 lb.; 2.7 lb.; 3.1 lb.; 3 lb.; 4 lb.; 5.2 lb.; 5.3 lb.; 5.4 lb.
2. 159.6 lb.; 218.4 lb.; 235.2 lb.; 226.8 lb.; 260.4 lb.; 252 lb.; 336 lb.; 436.8 lb. 445.2 lb.; 453.6 lb.
3. 6.49%
4. 3144.5 lb.

Section 85, page 128

1. 62.99%
2. 63¢
3. .45 lb.
4. 10.408 lb.
5. $2.29

Section 86, page 128

1. Lot 1, \$75.48; Lot 2, \$75.68; Lot 3, \$76.16; Lot 4, \$76.36
2. Lot 1, \$22.93; Lot 2, \$28.51; Lot 3, \$28.52; Lot 4, \$31.24
3. Lot 1, 356 lb.; Lot 2, 529 lb.; Lot 3, 589 lb.; Lot 4, 617 lb.
4. Lot 1, .2046 lb.; Lot 2, .294 lb.; Lot 3, .327 lb.; Lot 4, .3428 lb.
5. Lot 1, 1.043 lb.; Lot 2, 1.0558 lb.; Lot 3, 1.188 lb.; Lot 4, 1.0558 lb.
6. Lot 1, \$6.44; Lot 2, \$5.39; Lot 3, \$4.84; Lot 4, \$5.06
7. Lot 1, \$75.50; Lot 2, \$90.31; Lot 3, \$94.85; Lot 4, \$98.31
8. Lot 1, \$22.91; Lot 2, \$13.88; Lot 3, \$9.83; Lot 4, \$9.29
9. Lot 1, \$1.56; Lot 2, \$.85; Lot 3, \$.58; Lot 4, \$.53
10. Dry matter 2,999.12 lb.; protein 193.01 lb.; carbohydrates 1890.28; fats 102.201 lb.
11. 1:10.985

Section 87, page 130

1. 6.722 lb.; 6.295 lb.
2. 140.98 lb.
3. 89.87 lb.

Section 88, page 132

1. \$192.27
2. 7.9¢
3. 8.9¢
4. \$2.32
5. \$2.58
6. 1.133 lb.
7. 1.196 lb.
8. Corn 11.33 lb.; oats 11.33 lb.; oil meal 1.37 lb.; bran .935 lb.; timothy hay 23.92 lb.
9. \$175.03
10. 7.2¢
11. \$132.10
12. 6.63¢
13. Lot 2. \$17.24 cheaper
14. 1.0943 lb.
15. 1.185 lb.
16. 314.064 lb.
17. \$3.08

Section 89, page 134

1. Lot 1, 2198 lb.; Lot 2, 2268.0 lb.
2. Lot 1, 29.29¢; Lot 2, 19.03¢
3. Lot 1, \$96.91; Lot 2, \$69.46
4. \$702.96

Section 90, page 134

1. Lot 1, 214.56 bu.; Lot 2, 466.2 bu.
2. 155.38 bu.; 337.63 bu.
3. 139.43%
4. \$295.11
5. \$1.00
7. \$99.18; \$141.24

Section 91, page 135

1. \$14.53
2. 17.3¢
3. 7.6¢
4. \$17.43
5. 20.8¢
6. 6.97¢
7. \$18.24
8. 21.7¢
9. 11.54¢
10. \$36.48
11. 19¢
12. 11.4¢
13. \$31.32
14. 19.5¢
15. 12.53¢
16. \$112.04
17. 29.36¢
18. 17.8¢
19. \$28.90
20. \$17.43

Section 92, page 137

1. 679.9 lb.
2. 8.38¢
3. 610.6 lb.
4. 8.79¢

Section 93, page 139

	Spring	Summer	Fall	Winter		Spring	Summer	Fall	Winter
1.	48.95	38.5	1.3	20.1	2.	13.8¢	16.6¢	.16¢	11.8¢
	46.7	27.45	5.2	21.5			15.6¢	19.5¢	9.6¢
	51.7		35.9	22.1			22.4¢	13.4¢	12.3¢
	26.9	16.9	2.2	19.3		15.4¢	9.1¢	14.3¢	14.0¢
	27.3	21.0	1.0	15.3		21.7¢	20.5¢	15.2¢	10.0¢
	38.6	30.8	4.6	19.4		19.6¢	14.2¢	23.6¢	12.6¢
3.	.28¢	.43¢	12.3¢	.58¢					

		Spring	Summer	Fall	Winter
4.	Pen 1.	88¢	41¢	11.6¢	63.7¢
	Pen 2.	79.5¢	25.57¢	2.15¢	71.12¢
	Pen 3.	84.0¢	43¢	1.5¢	70.8¢
	Pen 4.	40.6¢	6.2¢	7.1	58.36¢
	Pen 5.	35.2¢	11.0¢	11.9¢	47.38¢
	Pen 6.	60.8¢	32¢	4.4¢	60¢

5. Pen 1, spring; pen 3, summer; pen 3, fall; pen 2, winter.

Section 94, page 140

1. .2375 oz.; .2364 oz.; .2381 oz.; .2581 oz.
2. 1.261 oz.; 1.240 oz.; 1.205 oz.; 1.310 oz.
3. 58.7%; 56.8%; 64.6%; 55.8%

Section 95, page 141

1. 12.9%
2. 16.125 lb.
3. 13.8 lb.
4. 88.5%
5. .545 lb.
6. 23.628 oz.
7. 2.3 qt.
8. 2.015 qt.
9. 20.15¢ per doz.
10. 2.428 qt.
11. 15.7¢
12. 18.85¢ per lb.
13. 48.4% water evaporated
14. 17.998 oz.

Section 96, page 142

1. Flour 4.5 lb.; fat 9 oz.; sugar .9 oz.; salt .9 oz.; baking powder 4.5 oz.
2. 16.99¢
3. Corn meal 2.2 lb.; flour 1.1 lb.; sugar .55 oz.; fat 2.99 oz.; baking powder 2.99 oz.
4. Corn meal, 2.2 lb.; flour 1.1 lb.; .sugar .55 oz; fat 2.933 oz.; baking powder 2.933 oz.
5. 17.024¢
6. Corn meal .6 lb.; flour .3 lb.; sugar .15 oz.; fat .8 oz.; baking powder 8 oz.
7. \$1.245; \$4.15
8. Sugar .6 lb.; 9 lemons
9. 1.875 cups cocoa; 1.875 cups sugar; 7.5 cups water; 22.5 cups milk

Section 97, page 144

1. 12 lb. sugar 2. 14.1¢ 3. $8.75 4. $1.58 5. $2.76 6. 3.03\frac{1}{3}$
7. 76.8¢ 8. 16.2¢ 9. $4.44 10. 24 lb. sugar 11. 98.83 lb.

Section 98, page 145

1. 288 lb. 2. 32 lb. 3. $3.12 4. 25¢ 5. 15¢

Section 99, page 146

1. 33.5¢ 2. 23¢ 3. 21.7¢ 4. 23.2¢ 5. 50.7%; 70.5%

Section 100, page 147

1. 60.36% 2. 60.8% 3. 63.9%

Section 101, page 147

3. 29.8¢ per lb. 4. 27.1¢ per lb.
5. 5.426 lb. lean; 3.141 lb. fat; 1.397 lb. bone

Section 102, page 148

1. Plate 87%; rib 75.6%; rump 73%; loin 71.5%; chuck 56.5%; neck 54.6%; hind shank 46%; fore shank 45.7%; round 63%; clod 42%
2. .00029¢; .00042¢

Section 103, page 149

1. 37$\frac{1}{2}$% 2. $1.20 3. 8¢ 4. $1.20 5. $1.57
6. $3.30 7. 40.92% 8. $1.35 9. $11.61 10. $2.05

Section 104, page 150

1. 25% 2. 39.90 3. $1.47 4. $15.40

Section 105, page 150

1. $468 2. $56.16 3. $540 4. $310 5. $1318 7. $158.16

Section 107, page 153

3. 14 hr., 26 min., 2 sec. 4. $46.71 5. $38.85 6. $50
7. 1038$\frac{1}{3}$ ft. 8. 28.512 T. 9. 17.5 lb. lime
10. 25.34 T. 11. 7.575 bbl. 12. 12 T. 13. 46$\frac{2}{3}$ lb. lime

Section 108, page 155

1. 21 parts milk 2. $\frac{1}{25}$ gal.

Section 109, page 157

1. 16, 64, 256 2. 4th 3. 3d 5. 9 sq. ft. 6. 25,600 sq. yd.

Section 110, page 157

1. 27^3, 8^4, 1^{12}, 36^7 2. 216, 16, 64

Section 112, page 158

1. (2 × 3) (2 × 3) (2 × 3) 2. (2 × 3 × 2 × 3) (2 × 3 × 2 × 3)
3. (5 × 5) (5 × 5)
4. [1] 10 [2] 12 [3] 20 [4] 25 [5] 18 [6] 28 [7] 30
[8] 50 [9] 60 [10] 42 [11] 21 [12] 32

Section 114, page 159

1. 18 2. 20 3. 52 4. 1.6 5. 111 6. 44.2 7. .9
8. .21 9. 160 10. 46 11. 62 12. 132 13. 452.548 rd.
14. 93.2 ft. 15. 10 mi. 268 rd. 6 ft. 16. 16.9 ft.
17. 14.3 ft.; 17.5 ft. 18. 24.62 ft. 19. 37.7 ft.

Section 115, page 162

2. 108 sq. ft. 3. 1280 sq. rd. 4. 160 sq. rd.
5. 20 A. 6. 200 sq. ft.

Section 116, page 163

1. 27 sq. ft. 2. 900 sq. chains

Section 117, page 163

1. One half 3. 896 sq. ft. 4. 23.13 ft. 5. 1157 squares
6. $28.93 7. $52.07

Section 118, page 164

1. 50.265 sq. ft. 2. 201.06 sq. ft. 3. $26.51

Section 119, page 165

1. 94.248 sq. ft. 2. $25.64 3. 2990.81 ft.

Section 120, page 165

2. 1360 cu. ft. 3. 1493⅓ bu. 4. 538.59 gal.
5. 269.28 qt. 6. 3⅓ cu. ft. 7. 72 bu.

Section 121, page 167

1. 63,108.46 gal. 2. 547,816.5 gal. 3. 36.52 gal.

Section 122, page 167

1. 8181.25 cu. ft. 2. 113.0976 cu. in.; 28.2774 cu in.
3. Water 2.36 lb.

Section 123, page 169

1. 183 line posts; 2 end posts 2. 318 line posts; 4 end; 3 corner
3. $141.09 4. $95.40 5. $7.05 6. $278.29

Section 124, page 170

1. 637 rd., 9½ ft. 2. 356 rd., 6 ft. 3. $267.20 4. $311.75
5. P. B. $35.00; J. L. $69.38; G. H. $98.38 6. $265.50 7. $263.98
8. $49.20 and $29.60 9. $289.20 10. $48.00 11. $540.10

Section 125, page 172

1. 1800 sq. ft. 2. 1632 sq. ft. 3. 14,688 cu. ft.
4. 9 ft. 5. $228.48 6. $10
7. 168 cu. ft. 8. 1080 cu. ft. 9. 1101.17 cu. ft.
10. 73.41 bbl. 11. 550.585 cu. ft. sand 12. $403.20
13. 1101.17 cu. ft. 14. 833⅓ board ft. 15. 51 joists
16. 3672 board ft. 17. 1725 board ft. 18. 1392 board ft.
19. 756 board ft. 20. 1080 board ft. 21. 3348 sq. ft.
22. 900 shingles 23. 30,456 shingles 24. 907.2 ft.

Section 126, page 175

1. $60.91 2. $138.14 3. $54.40 4. $253.45

Section 127, page 176

1. 164.5 cu. ft. 2. 23.5 cu. ft. 3. 819.96 cu. ft. 4. 1743.59 cu. ft.
5. 254.47 sq. ft. 6. 261.54 cu. ft. 7. 67.95 cu. yd. 8. 123.2 bbl.
9. Stone 67.95 yd.; gravel 34.24 yd. 10. $445

Section 128, page 177

1. 94,872 cu. ft. 2. 3750 cu. ft. 3. 26 flues 4. 936 sq. in.
5. 234 sq. in. 6. 54 sq. in. 7. 351 sq. in. 8. 83 glasses

Section 129, page 178

1. 28.35 cu. ft. 2. $14.18 3. $25.20 4. $26.75

Section 130, page 178

1. Ceiling 5 rolls; walls 8 rolls 2. Ceiling 12 rolls; walls 12 rolls
3. $16.74 4. $6.50

Section 131, page 180

1. 8.63 T. 2. $134.27 3. 58.9¢ 4. 22.67¢ 5. 7.91¢
6. 3.16¢ 7. 4.75¢, 2.88¢ 8. $1.00 9. $2.62 10. $9.17
11. 46, 30, 46, 37, 55, 46, 34, 224 cows.

Section 132, page 182

1. Horses 105; 500 lb. calves 88; stock cattle 53; beef cattle 42; dairy cattle 27; sheep 350 2. 336 days 3. 54 days
4. 35 cattle 5. 329 days 6. 24 stock cattle; 24 beef cattle; 644 days
7. 7 silos 8. 331 days 9. 134 sheep 10. 2 silos
11. 3 silos 12. 322 calves 13. $4.50 14. 31 cattle
15. 26 cattle 16. $4.17 17. 463 sheep 18. 447 sheep
19. 331 sheep 20. 297 days 21. 48.4 tons 22. 146 tons
23. 4.03 A. 24. 16 ft. 25. 26 ft. 26. 85 acres
27. 12 ft. 28. 30 ft. 29. 20 ft. 30. 12 ft.
31. 16 ft. by 24 ft. 32. 27 cows 33. 18 ft. 34. 18 ft.

Section 133, page 186

1. $1.95 2. 12.6¢ 3. 12.7¢ 4. 25.35¢ 5. $316.88
6. $18,930.45 7. $286.83 8. $41.15 9. Gross $245.68; net $233
10. 487.9 gal. 11. 9.75 lb. 12. 2.925 lb. of each
13. 2925 lb. lime; 2925 copper sulfate; .244 lb. Paris green
14. 3412.5 gal. 15. 5.69 lb. 16. .8775 lb. 17. 5.265 lb.

Section 134, page 188

1. 54.3% Bordeau; 65.1% lime sulphur 2. 7.2%
3. 3.79 bu. sprayed; .318 bu. unsprayed
4. 2.99 bu. sprayed; .515 bu. unsprayed
5. 7.69% Bordeau; 44% lime sulphur; 89% unsprayed;
6. Bordeau 7.13 bu.; Bordeau 8.16 bu.; lime sulphur 7.8 bu.; lime sulphur 8.48 bu.; no spray 3.73 bu.; no spray 5.22 bu.
7. Bordeau 3.29 bu.; lime sulphur 3.94 bu.

Section 135, page 190

1. 32.13¢ 2. $9.95 3. $3.49 4. $17.21 5. 922
6. Codlin moth 10.1%; curculio 74.1%; scab 8.15%; blotch .09%

7. Codlin moth 6.3 %; curculio 94.7%; scab 6.7 %; blotch .8%
8. Codlin moth 7.47%; curculio 88.7%; scab 7.1 %; blotch .6%
9. Codlin moth 11.01%; curculio 89.2%; scab 7.06%
10. Codlin moth 8.8 %; curculio 96.5%; scab 8.8 %; blotch 6.2%
11. Codlin moth 9.27%; curculio 94.9%; scab 8.4 %; blotch 4.9%
12. Codlin moth 47.8 %; curculio 99.3%; scab 42.9 %; blotch 5.6%
13. Codlin moth 5.7 %; curculio 99.9%; scab 66.2 %; blotch 11.1%
14. Codlin moth 52.4 %; curculio 99.6%; scab 54.6 %; blotch 8.4%

Section 136, page 192

1. 90,000 sq. ft. 2. 900 sq. ft. 3. 1%

Section 137, page 193

1. \$136.10 2. \$326.64 3. \$22.68 4. \$45.37
5. \$72.60 8. \$484 9. \$145.20 10. \$31

Section 138, page 195

3. \$1.10 4. 3.12¢ 5. \$148.45 6. \$71.54
7. 45¢; 60¢; 72¢; \$1.35; 10¢; 10¢; 8¢ 8. 10¢ 9. 78¢

Section 140, page 200

1. \$5700 2. \$8460 3. \$1460 4. \$1020

Section 141, page 203

1. \$7800 2. \$2000 3. \$9501 4. \$6412

Section 142, page 210

2. \$1260 3. \$507.61 4. \$1552.50 5. \$137.50
6. \$50 7. \$32.55 8. \$125.10 9. 26⅔%
10. 9.8% 11. \$14,250 12. \$780. 13. \$50.10

Section 143, page 212

1. \$2962

Section 144, page 214

1. 85¢ per hundred 2. \$33.60 3. \$2672
4. 3697.48 interest and principal 5. \$350

Section 145, page 214

1. \$4200 2. \$6000

Section 146, page 217

1. \$410 2. \$432
3. State \$1.288; county \$.784; town \$.168; outside corporation \$.896; corporation \$3.976; school \$7.84
4. State \$3.197; county \$1.946; town \$.417; outside corporation \$2.224; inside corporation \$9.869; school \$19.46 5. \$179.64
6. State \$9.17; county \$5.59; bridge and road \$7.98; school \$24.74
7. \$34.75

Section 147, page 219

2. 387.75 hr. 3. 19.3¢ per hr. 4. 302.25 hr. 5. 16.5¢
6. 96¼ hr.; 90½ hr.; 47½ hr. 7. \$16.84; \$15.84; \$8.31;
8. 383.25 hr. 9. 15.65¢ 10. 75 hr.; \$13.13
11. Marsh \$9.98; Carr \$15.05 12. 1525.50 hr. 13. 17.33¢
14. 595.25 hr. 16. \$14.88 17. 388 hr. 18. \$264.32
19. \$10.69 20. 30.55% 21. \$12.31 22. \$6.16
23. \$2248.40

Section 148, page 222

1. Cow No. 1, 1030.9 lb.; Cow No. 2, 1019.4 lb.; Cow No. 3, 995.5 lb.; Cow No. 4, 667.9 lb.; Cow No. 5, 1100.3 lb.
2. Cow No. 1, 33.25 lb.; Cow No. 2, 32.88 lb.; Cow No. 3, 32.11 lb.; Cow No. 4, 21.54 lb.; Cow No. 5, 35.49 lb.
3. Cow No. 1, 36.08 lb.
4. Cow No. 2, 32.21 lb.; Cow No. 3, 34.84 lb.; Cow No. 4, 24.71 lb.; Cow No. 5, 36.86 lb.
5. Cow No. 1, 1.16 lb.; Cow No. 2, 1.04 lb.; Cow No. 3, 1.12 lb.; Cow No. 4, .80 lb.; Cow No. 5, 1.19 lb.
6. Cow No. 1, \$11.55; Cow No. 2, \$10.31, Cow No. 3, \$11.15; Cow No. 4, \$7.91; Cow No. 5, \$11.80
7. Cow No. 1, \$.37; Cow No. 2, \$.33; Cow No. 3, \$.36; Cow No. 4, \$.26; Cow No. 5, \$.38
8. \$52.72
9. Cow No. 1, 472.89 qt., Cow No. 2, 467.61 qt., Cow No. 3, 456.65 qt., Cow No. 4, 306.38 qt., Cow No. 5, 509.72 qt.
10. 3.42% 11. 205.875 lb.
12. Cow No. 1, 1.43 lb., Cow No. 2, 1.3 lb., Cow No. 3, 1.4 lb., Cow No. 4, 1.00 lb., Cow No. 5, 1.49 lb.
13. \$18.36 14. \$177.06

Section 149, page 224

1. $3788.77 2. 39.47% 3. $13,388.77 4. $803.33

Section 150, page 227

1. $429.91 2. $413.74 3. $37.66 4. $53.38
5. $414.29 6. $98.01 7. $171.08 8. $356.84

Section 151, page 229

1. $35.39; $1.94 2. $33.45 3. $238.94 4. $6.59
5. $6.23 6. $30.36 7. $448.35 8. $59.29

Section 152, page 230

1. $486 2. $65.25 3. $43.92 4. $507.33 5. 67.31%

Section 153, page 231

1. $513.63 2. $93.61 3. $402.02 4. 377 bu. 5. $45.60 6. $138.60
7. $274.48 8. $26.29 9. $248.19 10. $137.33 11. $488.35

Section 154, page 232

1. $48.07 2. $21.85 3. $108.62

Section 155, page 233

1. $20.33 2. 20.33
3. Mrs. Greason $1; Creamery $8.40; School District $16; Mrs. Sherpy $1.; Mrs Dunlap $.40; Family Expense $12.39; Farm Expense $29.96; Mercantile Company $11.96
4. $9.86 5. $29.96 6. $2.89 7. 60.53%

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